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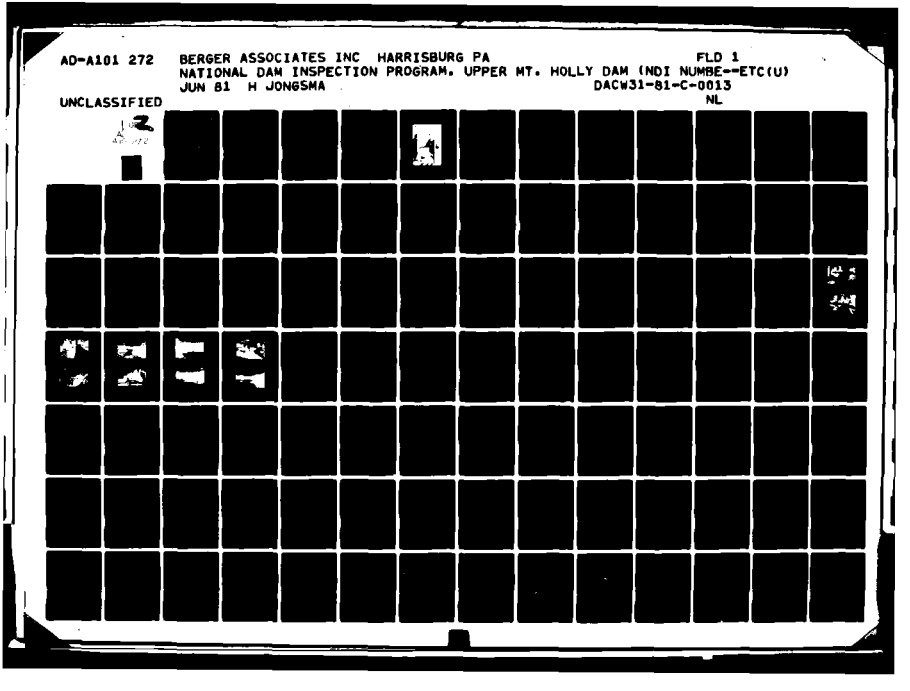

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AD A101272

# SUSQUEHANNA RIVER BASIN

# UPPER MT. HOLLY DAM
# EATON – DIKEMAN OF KNOWLTON BROS.

## NDI NO. PA-00583
## DER NO. 21-001

## CUMBERLAND COUNTY, PENNSYLVANIA
## PHASE I INSPECTION REPORT
## NATIONAL DAM INSPECTION PROGRAM

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PREPARED FOR
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

BY
Berger Associates
Harrisburg, Pennsylvania 17105

Contract DACW31-81-C-0013

JUNE 1981

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## PREFACE

This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS
AND RECOMMENDATIONS

Name of Dam: UPPER MT. HOLLY DAM

State & State No.: PENNSYLVANIA, 21-001

County: CUMBERLAND

Stream: MOUNTAIN CREEK

Date of Inspection: OCTOBER 16, 1980

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in poor condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small and the hazard classification is high. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. The recommended SDF for this structure is one-half the PMF. The spillway capacity is adequate for passing only 4 percent of the PMF peak inflow without overtopping the dam. The spillway is considered to be seriously inadequate, and the facility is classified as unsafe, non-emergency.

The following recommendations are presented for immediate action by the owner:

1. That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for providing adequate spillway capacity.

2. That the upstream and downstream slopes and the crest be cleared of all trees, brush and weeds under the supervision of a professional engineer, experienced in the design and construction of dams. The embankment shall be maintained on a regular basis.

3. That after clearing, the right embankment be inspected for signs of seepage, sloughs and other indications of instability.

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UPPER MT. HOLLY DAM NDI NO. PA-00583 DER NO. 21-001

EATON-DIKEMAN OF KNOWLTON BROTHERS CUMBERLAND COUNTY

4. That the left embankment be widened and be provided with a protective vegetative cover.

5. That trees in the spillway riprap be removed and that the voids in the riprap be filled.

6. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

7. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

8. That, in lieu of improving the facilities, the embankment be breached after obtaining a permit from the Bureau of Dam Safety, Obstruction and Storm Water Management, Pennsylvania Department of Environmental Resources.

(15) DACW31-81-C-0013

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: June 5, 1981

(10) COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER HENDRIK JONGEJAN

APPROVED BY:

JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 17 June 1981

(6) National Dam Inspection Program. Upper Mt. Holly Dam (NDI Number PA-00583, DER Number 21-001), Susquehanna River Basin, Cumberland County, Pennsylvania. Phase I Inspection Report.



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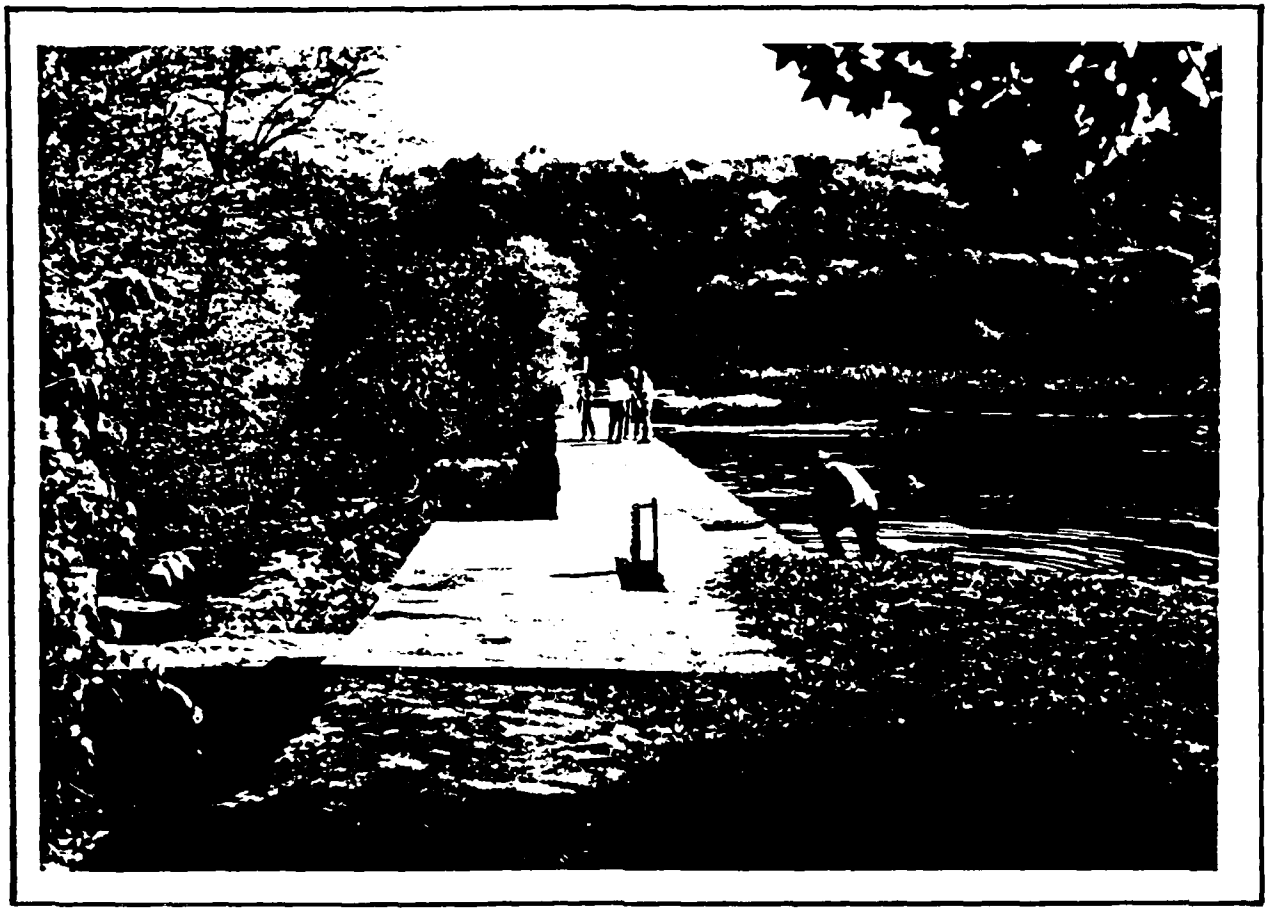

OVERVIEW FROM LEFT ABUTMENT

UPPER MT. HOLLY DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

UPPER MT. HOLLY DAM

NDI NO. PA-00583
DER NO. 21-001

## SECTION 1 - PROJECT INFORMATION

### 1.1 GENERAL

#### A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

#### B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

### 1.2 DESCRIPTION OF PROJECT

#### A. Description of Dam and Appurtenances

Note: Pool elevation is shown on the U.S.G.S. quadrangle sheet at elevation 594. This elevation is used in this report as the spillway crest elevation. This compares to an elevation of 96.7 shown on Plate III, Appendix E, including the 3 inches of concrete topping.

Upper Mt. Holly Dam is an earthfill structure with a maximum embankment height of 13 feet. The dam was constructed in 1855 to provide power for water wheels at a mill located about 700 feet downstream of the dam. A 206 foot wide spillway is located near the left abutment. The embankment to the right of the spillway is about 420 feet long. The right abutment ties into a railroad bridge over the headrace. Three wooden slide gates control the flow to the downstream mill where the water is used for industrial purposes.

A non-operable wooden sluice gate is located at the left end of the spillway. The gate is blocked by debris.

#### B. Location

Borough of Mt. Holly Springs, Cumberland County
U.S.G.S. Quadrangle - Mt. Holly Springs, Pa.
Latitude 40°-06.0', Longitude 77°-11.0'
Appendix E, Plates I & II

D. Size Classification: Small: Height - 13 feet
Storage - 140 acre-feet

D. Hazard Classification: High (Refer to Section 3.1.E.)

E. Ownership: Eaton Dikeman
Division of Knowlton Brothers
Mr. Philip H. Avery, President
Mt. Holly Springs, PA 17065

F. Purpose: Water Supply

G. Design and Construction History

The dam was constructed in 1855 by four gentlemen living in Mt. Holly Springs. The original spillway consisted of a planked weir. The structure was first inspected by a state representative in June 1914, and a report was prepared. Records indicate that the dam was breached by floods at least five times. Many repairs and improvements have been made over the years. Reference is made to Section II of this report for recorded modifications.

H. Normal Operating Procedures

Water for industrial use is regulated by the sluice gates in the headrace and by valves on the pipe intake at the mill. All inflow above the spillway crest is discharged over the spillway. The sluice gate in the left spillway abutment is not operable.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

| | |
|---|---|
| From files: | 44.1 |
| Computed for this report: | 44.43 |
| Use: | 44.43 |

B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations.

| | |
|---|---|
| Maximum known flood (estimated from records of U.S.G.S. gage on nearby Yellow Breeches Creek) | 5447 |
| Outlet works low pool outlet at pool Elev. 590 | 194 |
| Outlet works at pool level Elev. 594 (spillway crest) | 309 |

| | |
|---|---|
| Spillway capacity at pool Elev. 596.7 (low point of dam) | 2018 |

C. Elevation (feet above mean sea level)

| | |
|---|---|
| Top of dam (design) | 597.3 |
| Top of dam (low point as surveyed) | 596.7 |
| Spillway crest (low flow notch) | 594 |
| Upstream portal invert | 584.9 |
| Downstream portal invert | 584.2 |
| Streambed at downstream toe of dam (estimate) | 584 |

D. Reservoir (miles)

| | |
|---|---|
| Length of normal pool | 0.4 |
| Length of maximum pool | 0.5 |

E. Storage (acre-feet)

| | |
|---|---|
| Spillway crest (Elev. 594 including siltation) | 61 |
| Top of dam (Elev. 596.7) | 140 |

F. Reservoir Surface (acres)

| | |
|---|---|
| Top of dam (Elev. 596.7) | 43 |
| Spillway crest (Elev. 594) | 20 |

G. Dam

Refer to Plate III in Appendix E for plan and section.

Type: Homogeneous earthfill.

Length: 700 feet.

Height: 13 feet.

Top Width: Design - 12 feet; Survey - Varies.

| Side Slopes: | Design | Surveyed |
|---|---|---|
| Upstream | 2.5H to 1V | Irregular |
| Downstream | 2H to 1V | Irregular |

Zoning: None.

Cutoff: Unknown.

Grouting: None.

H. Outlet Facilities

Drawdown: 6' x 16' concrete arch.

Type: Outlet tunnel.

Location: Near left abutment.

Closure: 5' x 5' timber gate on downstream end.

Upstream Invert: 584.9

Downstream Invert: 584.2

Headrace

Type: Concrete slide gate structure.

Location: Near right abutment.

Closure: Three 5' x 5' timber gates.

Invert: 589.6

I. Spillway

Type: Uncontrolled, broad crested, concrete weir with low flow notch.

Length: 206 feet, including 16 foot long low flow notch.

Crest Elevation: Low flow notch: 594.0
Spillway: 594.2

Location: Near left end of dam.

J. Regulating Outlet

See Section 1.3.H.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Engineering design data for the original Upper Mt. Holly Dam, which was constructed in 1855, do not exist. A report in the files of the Pennsylvania Department of Environmental Resources, dated June 1914, indicates that the dam was constructed by four persons by the names of Kempton, Given, McArgis and Mullen. The report states that the original dam had a planked spillway at the location of the existing spillway. This spillway failed in 1863 and was replaced with a masonry gravity section. An auxiliary 40 to 50 foot wide timber spillway was located near the railroad. This auxiliary spillway failed in 1889 and 1909. At the time of first PennDER inspection in 1914, the embankment had a top width of 12 feet and 2H to 1V side slopes. The report indicates that the dam site had been stripped of debris, boulders and muck prior to construction and that the spillway was founded on hardpan. This hardpan was at a varying depth of 2 to 10 feet below the creek bed.

The drawdown facility consisted of three 5' x 5' cast iron gates in the left spillway abutment. The report indicates that the dam was in poor condition. The timber auxiliary spillway was rotting, the gravity spillway was disintegrating and the embankment was overgrown and had an uneven crest. The total spillway capacity was approximately 3260 cfs. The required capacity was 175 cfs per sq. mile, or 7720 cfs. The owner was requested to repair the structure or to breach it.

Plans were prepared in October 1914 by Mr. C.A. Bryan, Carlisle, Pennsylvania, for repairs. These plans included the raising of the embankment profile from the existing 2.3 feet to 6.0 feet above the spillway crest. These plans were approved on May 15, 1915. Before any changes were made, the dam was breached by overtopping on August 21, 1915, over a length of 26 feet.

A report states that the breach had caused only minor damage in Mt. Holly Springs, although it was difficult to establish what additional damage had been caused by the failure of the dam. The breach showed that the embankment had been constructed mostly of a sandy material with only a slight mix of clay at the upstream side. A large amount of fist-sized stone was in the fill material.

The breach was filled in the fall of 1915 with "good material." However, the owners refused to implement other improvements. The new fill settled about ten inches over the next year. In June 1919, the dam breached again at the location of the auxiliary spillway. The breach was 43 feet wide and 9 feet deep. Considerable damage was reported in the Borough. The owners, who had acquired the dam just before the breach occurred, constructed a concrete gravity section in the breach. This wall, described as 4'-7" wide on top and about 13 feet high, was constructed without a permit. The top seven feet of the wall were

exposed and had sloping surfaces with a width of about seven feet at the ground elevation.

PennDER requested plans, which were submitted in 1922 (Plate III, Appendix E). After approval, all repairs were made. The repairs included the removal of brush and trees, the raising of the embankment to elevation 100.0, and the leveling of the spillway crest with three inches of concrete to elevation 96.7. The embankment was not raised to elevation 102.0, as shown on Plate III, Appendix E.

Inspection reports between 1924 and 1940 indicate that seepage occurred along the toe, that the crest was uneven and brush and trees were growing on the embankment. The abutment walls of the auxiliary spillway cracked and settled.

The dam was obtained by the present owners in 1940. In 1942, the area of the auxiliary spillway was backfilled to an elevation matching the top of the dam. It is unknown whether or not the gravity section was removed.

The overall condition of the facility deteriorated and PennDER suggested in 1952 to rebuild the facilities. The owners engaged the Gunite Construction Corporation, New York, New York, to gunite the spillway, as shown on Plate IV, Appendix E. All work was completed in December 1952, and the facilities were reported to be in good condition.

The last State inspection occurred in December 1959, and indicated that the dam was in fair condition. Brush on the embankment and seepage along the toe were reported.

## 2.2 CONSTRUCTION

Records of construction do not exist.

## 2.3 OPERATION

Records of operation are not maintained by the owner. The available inspection reports indicate that the dam was breached five times. Statements indicate that most failures occurred in the auxiliary spillway prior to actual overtopping of the embankment.

## 2.4 EVALUATION

### A. Availability

The described history and design data of this dam are located in the files of PennDER, Harrisburg, Pennsylvania.

B. Adequacy

Because of the lack of engineering data, the assessment of the dam is based on the results of the visual inspection.

C. Operating Records

Operating records have not been maintained.

D. Post Construction Changes

Numerous alterations have been made to the original structure constructed in 1855. Reference is made to Section 2.1 of this report for a detailed description.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### A. General

The general appearance of Upper Mt. Holly Dam is poor. The earth embankment is overgrown with brush and trees and the slopes are uneven. The riprap at the downstream side of the spillway has several voids and several trees are growing in this area. The reservoir is silted for most of its storage area at normal pool elevation. The drawdown sluice gate leaks and is inoperable.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Photographs of the facilities taken during the inspection are reproduced in Appendix C.

Messrs. Guise and Wardwell represented the owner and accompanied the inspectors on the day of inspection.

#### B. Embankment

Earthfill embankments are located to the left and right of the spillway. The left embankment is in poor condition. It has a very narrow crest (2 to 5 feet) without any protective cover. Many trees are located on this embankment (Photograph No. 2). The right embankment is also in a poor condition. The vertical profile is irregular, and a heavy growth of weeds, brush and trees cover the embankment (Photograph No. 9). Close inspection for seepage, sloughs and other signs of instability was not possible. It appeared that the downstream and upstream slopes were irregular.

It was not possible to survey a typical cross section. The embankment crest appears to be about nine feet above the downstream toe. The right embankment ties into a railroad embankment. The wingwall of a railroad bridge over the headrace has been extended with a concrete wall at the upstream side of the embankment (Photograph No. 10).

#### C. Appurtenant Structures

The spillway is located near the left abutment and consists of an 8.5 foot wide, broad crested weir. The original masonry weir has been gunited on the top and on part of the downstream side. Some seepage through the wall was detected about one to two feet below the crest. The gunited surface was in fair condition. Several cracks have developed. A low flow notch is located in the left half of the spillway (Photograph No. 6). The spillway abutments are in good condition. The right abutment has been gunited (Photograph No. 5).

The downstream side of the spillway is protected with hand laid riprap (Photograph No. 4). Several voids have developed in this surface and several trees are growing on this surface. Both conditions could cause further erosion of this protection.

A large (16' x 6') arch opening is located in the left spillway abutment on the upstream side. A part of the opening has been blocked off with concrete and the only drawdown opening is a 5 foot by 5 foot opening closed with a timber gate. The mechanism to open the gate has disappeared (Photograph No. 1), and the gate is inoperable. The timber gate leaks considerably (Photograph No. 7). The concrete abutment walls are in good condition.

Siltation of reservoir has reached a point one to two feet below the weir crest. The flow to the headrace is along the right abutment and passes under the railroad bridge. The race makes a 90 degree bend and after this bend the flow is controlled in a structure with three 5 foot by 5 foot timber gates. These gates appear to be in good condition. Flow release through these gates are limited to prevent flooding of the mill.

D. Reservoir Area

The reservoir has been silted for a large part. Fishermen report that there are still areas about six feet deep, but the larger area is only one to two feet deep. Large portions of the reservoir are overgrown with weeds.

The left side of the reservoir has a steep, wooded slope; the right side is flat.

Laurel Lake Dam is located about seven miles upstream from the dam. This dam (PA DER No. 21-25) is a concrete gravity dam having a 200 foot long ogee section spillway with 11.5 feet of freeboard. A Phase I inspection was completed on Laurel Lake Dam in 1979. This upstream reservoir was included in the computations in Appendix D.

E. Downstream Channel

A paper mill is located about 700 feet downstream from the dam. The stream runs through a wooded area and then through a narrow valley parallelling Route 34 and a railroad. The valley widens about 4,000 feet below the dam and the stream runs through the Borough of Mt. Holly Springs. A potential hazard to loss of life of more than a few exists downstream if the dam would fail. The hazard category for the Upper Mt. Holly Dam is considered to be "High."

## 3.2 EVALUATION

The overall evaluation of these facilities indicates that Upper Mt. Holly Dam is in poor condition. The growth of brush and trees on the embankment and in the downstream area of the spillway should be removed.

After this clearing, the embankment should be inspected for seepage and signs of instability. The embankment should be made level and should be protected against erosion with a good grass mat. The riprap at the downstream side of the spillway should be repaired.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Upper Mt. Holly Dam was constructed for and is still used for industrial purposes. Maintenance procedures appear to be non-existent. The gates on the headrace appear to be operated only occasionally.

### 4.2 MAINTENANCE OF DAM

The inspection indicates that there is no maintenance performed on the embankment. Trees, brush and weed growth are not controlled.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

The drawdown facility in the left spillway abutment has not been used in at least 10 years and is inoperable at the present time.

### 4.4 WARNING SYSTEM

There is no formally organized surveillance and downstream warning system in existence at the present time.

### 4.5 EVALUATION

Operational procedures for these facilities are non-existent. It is recommended that a regular maintenance procedure be developed for the dam, which should include the control of weed and brush growth on the embankment and the maintenance of the spillway.

A formal surveillance plan and downstream warning system should be developed for implementation during periods of heavy or prolonged precipitation.

## SECTION 5 - HYDROLOGY/HYDRAULICS

### 5.1 EVALUATION OF FEATURES

#### A. Design Data

The hydrologic and hydraulic analysis available from PennDER for Upper Mt. Holly Dam was not very extensive. No unit hydrograph, design storm, design flood hydrograph, or flood routings were available. The PennDER files did contain discharge rating tables for the spillways and discharge outlets as they existed in 1914.

#### B. Experience Data

It was reported that the dam was overtopped several times and was breached on five occassions. However, there are no records of flood levels at Upper Mt. Holly Dam. Based on records of the U.S.G.S. stream gage on Yellow Breeches Creek at nearby Camp Hill, Pennsylvania, the maximum inflow to Upper Mt. Holly Dam occurred in September 1975. The estimated maximum inflow was 5447 cfs.

#### C. Visual Observations

It was noted that the 5 foot by 5 foot gate on the outlet conduit was inoperable. This gate was leaking badly (see Photograph No. 7). No other conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily until the dam is overtopped. Upstream of Upper Mt. Holly Dam is Laurel Lake Dam, a recreational facility. This upstream impoundment was included in the computations contained in Appendix D.

#### D. Overtopping Potential

Upper Mt. Holly Dam has a total storage capacity of 140 acre-feet and an overall height of 13 feet above streambed. These dimensions indicate a size classification of "small." The hazard classification is "high" (see Section 3.1.E.).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. Because of the small size of this dam, the recommended SDF is one-half the PMF. The SDF peak inflow is 32,938 cfs (see Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 32,938 cfs with the estimated spillway discharge capacity of 2,018 cfs indicates that a potential for overtopping of the Upper Mt. Holly Dam exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam does not have the necessary storage available to pass the SDF without

overtopping. The spillway-reservoir system can pass a flood event equal to 4% of a PMF without overtopping based on the existing low point of the dam profile.

E. Dam Break Evaluation

A restaurant is located about 4,300 feet downstream from the dam. Just downstream of the restaurant is the residential area of Mt. Holly Springs. On the basis of the results of the dam break analysis, using the U.S. Army Corps of Engineers HEC-1 program, the water surface elevations in the vicinity of the restaurant have been compared for several conditions prior to and after a dam break (refer to Table 1, Appendix D). For an earth dam, it is estimated that 0.5 foot of overtopping would result in a breach. Calculations indicate that 6 percent of the PMF inflow would cause an overtopping of 0.5 foot. The increase in water levels downstream due to overtopping of 0.5 foot with no failure as compared to no overtopping would be 2.5 feet. While more property would be exposed to flooding, the increase in the hazard to loss of life is not considered significant. With failure, the breaching analysis indicates a rise of 2.6 feet above the flow level just prior to breach when considering a .25 hour time to complete the breach and 1.2 foot rise above flow level just prior to breach when considering a two hour time to complete the breach. The increase in hazard to loss of life and property damage is reflected not only in the increase in depth of water of 2.6 feet in the 15 minute breach and 1.2 feet in the two hour breach, but more significantly in the shorter time to reach the peak. Less time would be available to respond to the flooding under the breach conditions.

Being an earth embankment, it is judged that the breach would be completed between the 15 minute and the two hour period. The numerical difference of water levels is 1.4 feet. The property damage would be similar with either time of failure. The time factor, however, is most significant regarding loss of life. Calculations indicate that the water depth will increase at a rate of 2.6 feet in 30 minutes under the .25 hour breach condition.

One large manmade dam is located upstream of Upper Mt. Holly Dam. For this evaluation, this impoundment was not considered to have breached (see Appendix D).

On the basis of these calculations, it is concluded that the hazard to loss of life and property damage is significantly increased when the dam is overtopped and failed as compared to the condition just prior to failure.

Refer to Table 1, Appendix D, for comparison of flood water levels.

F. Spillway Adequacy

Calculations show that the spillway discharge capacity and reservoir storage capacity combine to handle 4% of the PMF (refer to Appendix D).

Since the spillway discharge and reservoir storage capacity cannot pass one-half of the PMF, the downstream hazard to loss of life is high, and this hazard is significantly increased when the dam fails as compared to just prior to failure; the spillway is therefore judged to be seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### A. Visual Observations

##### 1. Embankment

The visual inspection of Upper Mt. Holly Dam did not detect any signs of seepage through the embankment. A heavy growth of brush and trees prevented close observation of the embankment. It appeared, however, that the upstream and downstream slopes are uneven. The left end of the embankment has a barren, narrow crest.

##### 2. Appurtenant Structures

The spillway weir appears to be stable. The gunite surface has cracked and some seepage through the gravity section is occurring. To prevent future erosion, the trees in the downstream slope should be removed and the voids should be filled.

#### B. Design and Construction Data

Design and construction data for this dam are too limited to make an engineering evaluation. Reports indicate that the dam was breached at least five times. The first breach occurred at the main spillway, which consisted of a timber construction. This was replaced by the present masonry structure, which has since been capped with concrete. All other breaches occurred at the auxiliary spillway near the railroad. These breaches occurred by failure of the timber structure or by seepage along the smooth backface of the abutment of this spillway.

#### C. Operating Records

Operating records for this dam have not been maintained by the owner.

#### D. Post Construction Changes

Many construction changes have occurred since the completion of the dam in 1855. Reference is made to Section 2.1 of this report for the recorded history of these changes.

#### E. Seismic Stability

This dam is located in Seismic Zone 1, and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

## SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

### 7.1 DAM ASSESSMENT

#### A. Safety

The visual inspection indicates that Upper Mt. Holly Dam is in poor condition. Engineering and construction data are limited or non-existent. Reports indicate that five breaches have occurred. However, since the auxiliary spillway was replaced by an embankment, no other failures have been reported. Maintenance procedures are non-existent. Removal of trees and brush is recommended.

The hydrologic and hydraulic computations indicate that the combination of the storage capacity and the discharge capacity of the spillway are sufficient to pass only four percent of the PMF without overtopping the embankment. The recommended SDF is fifty percent of the PMF. Failure of the dam could occur with six percent of the PMF. The hazard to loss of life is significantly increased when the dam fails. The spillway is considered to be seriously inadequate and the facility is classified as unsafe, non-emergency.

#### B. Adequacy of Information

The visual inspection is considered to be sufficiently adequate for making a reasonable assessment of this dam.

#### C. Urgency

The recommendations presented below should be implemented immediately.

#### D. Additional Studies

A detailed hydrologic and hydraulic study is recommended to determine methods of improving the spillway capacity.

### 7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of this dam, the following recommendations are presented for immediate implementation by the owner:

1. That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for providing adequate spillway capacity.

2. That the upstream and downstream slopes and the crest be cleared of all trees, brush and weeds under the supervision of a professional engineer experienced in the design and construction of dams. The embankment shall be maintained on a regular basis.

3. That after clearing, the right embankment be inspected for signs of seepage, sloughs and other indications of instability.

4. That the left embankment be widened and be provided with a protective vegetative cover.

5. That trees in the spillway riprap be removed and that the voids in the riprap be filled.

6. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

7. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

8. That, in lieu of improving the facilities, the embankment be breached after obtaining a permit from the Bureau of Dam Safety, Obstruction and Storm Water Management, Pennsylvania Department of Environmental Resources.

# APPENDIX A

## CHECK LIST OF VISUAL INSPECTION REPORT

# CHECK LIST

## PHASE I - VISUAL INSPECTION REPORT

PA DER # 21-001 NDI NO. PA-00583

NAME OF DAM Upper Mt. Holly Dam HAZARD CATEGORY High

TYPE OF DAM Earthfill with concrete overflow.

LOCATION South Middleton TOWNSHIP Cumberland COUNTY, PENNSYLVANIA

INSPECTION DATE 10/16/80 WEATHER Sunny TEMPERATURE 70's

| INSPECTORS: | OWNER'S REPRESENTATIVE(s): |
|---|---|
| H. Jongsma (Recorder) | |
| R. Shireman | George E. Guise |
| A. Bartlett | Bob Wardwell |
| J. Watson | |
| | |

NORMAL POOL ELEVATION: 594.0 (U.S.G.S.) AT TIME OF INSPECTION: 594.0

BREAST ELEVATION: 596.7 (low point) POOL ELEVATION: 594.0+

SPILLWAY ELEVATION: 594.0 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION:

GENERAL COMMENTS:

Earthfill dam on right side overgrown with weeds, brush and trees and has the appearance of no maintenance.

Concrete overflow section in fair condition.

Left end of embankment in poor condition.

NDI NO. PA-00 583

VISUAL INSPECTION
EMBANKMENT

| | OBSERVATIONS AND REMARKS |
|---|---|
| A. SURFACE CRACKS | None detectable in heavy brush. |
| B. UNUSUAL MOVEMENT BEYOND TOE | None detected. |
| C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES | None detected. Heavy brush prevents close inspection. Upstream and downstream slopes are uneven. |
| D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL: | Horizontal alignment appears to be good. The left end curves to mountainside. For vertical profile see Plate A-II. |
| E. RIPRAP FAILURES | No riprap. |
| F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY | Left embankment has only a narrow crest (2 to 5 feet). Right embankment ties in to railroad embankment. |
| G. SEEPAGE | None detected. |
| H. DRAINS | None. |
| J. GAGES & RECORDER | None. |
| K. COVER (GROWTH) | Left embankment bare and some trees. Right embankment overgrown with brush, weeds and trees. |

NDI NO. PA-00 583

## VISUAL INSPECTION
## OUTLET WORKS

| | OBSERVATIONS AND REMARKS |
|---|---|
| A. INTAKE STRUCTURE | Concrete arch opening (16' x 6') at upstream side. Closed with timber gate. |
| B. OUTLET STRUCTURE | 5' x 5' timber gate opening in concrete wall and is inoperable. Gate leaks badly. Some leakage adjacent to gate on right. |
| C. OUTLET CHANNEL | Channel with heavy, gunited walls, then natural stream. |
| D. GATES | Timber gate 5' x 5' (inoperable). |
| E. EMERGENCY GATE | Timber gate (inoperable). |
| F. OPERATION & CONTROL | Have not been operated in at least 10 years. |
| G. BRIDGE (ACCESS) | None. Close to left abutment which is accessable by car. |

NDI NO. PA-00 583

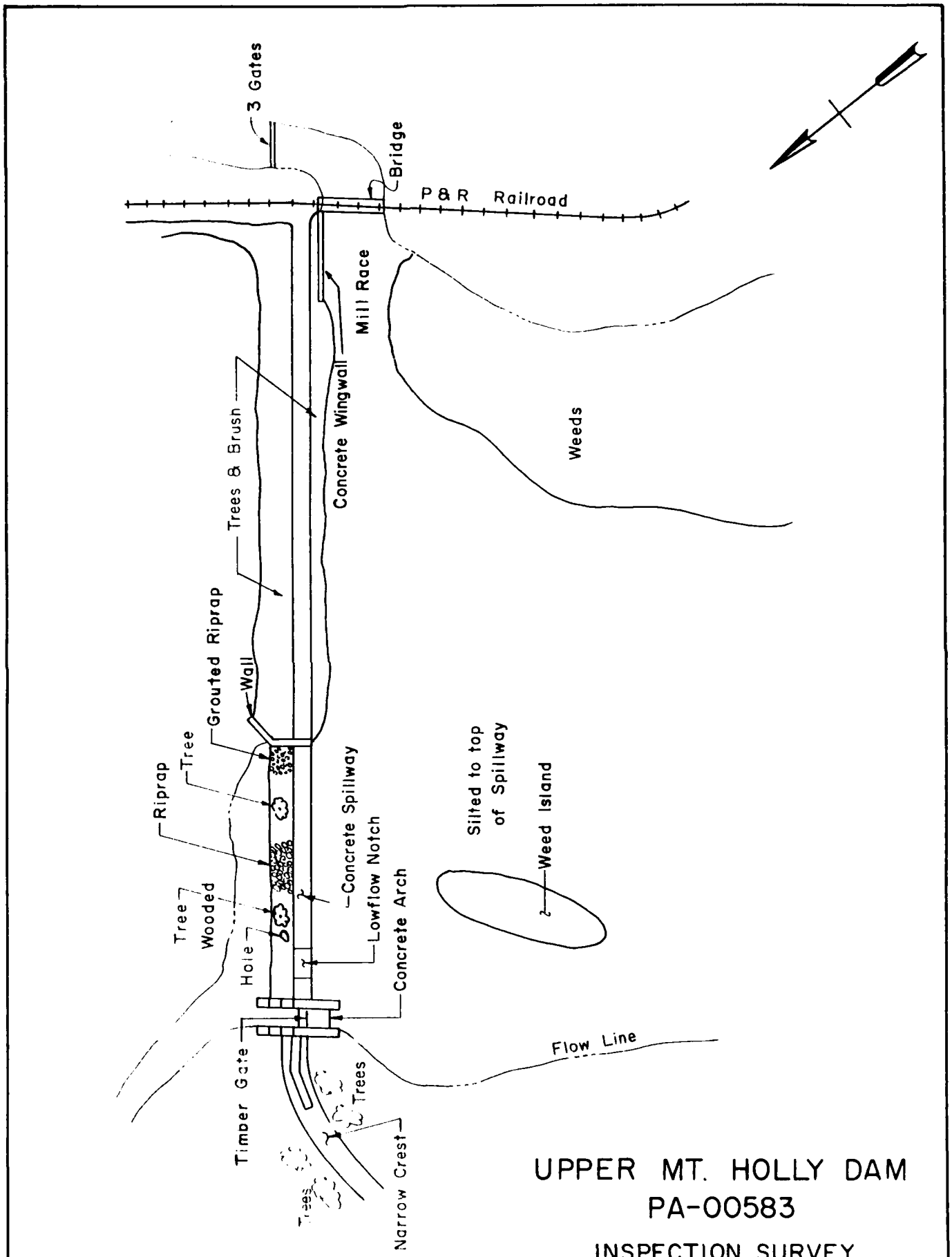
VISUAL INSPECTION
SPILLWAY

| | OBSERVATIONS AND REMARKS |
|---|---|
| A. APPROACH CHANNEL | Direct from reservoir. |
| B. WEIR:<br>Crest Condition<br>Cracks<br>Deterioration<br>Foundation<br>Abutments | A low flow notch in the left half of concrete overflow section. Broad crested weir in fair condition. Weir is gunited on stone wall. Some seepage about one to two feet below crest. Some cracks in weir. Overflow section has hand laid riprap at downstream side. Seepage not detrimental to safety of structure. |
| C. DISCHARGE CHANNEL:<br>Lining<br>Cracks<br>Stilling Basin | Riprapped steep section. Small stream and woods. Some trees on riprap. |
| D. BRIDGE & PIERS | None, except railroad bridge over mill race. |
| E. GATES & OPERATION EQUIPMENT | None, except three 5' x 5' gates on mill race. |
| F. CONTROL & HISTORY | Unknown. Left abutment was overtopped with Agnes. |

NDI NO. PA-00 583

## VISUAL INSPECTION

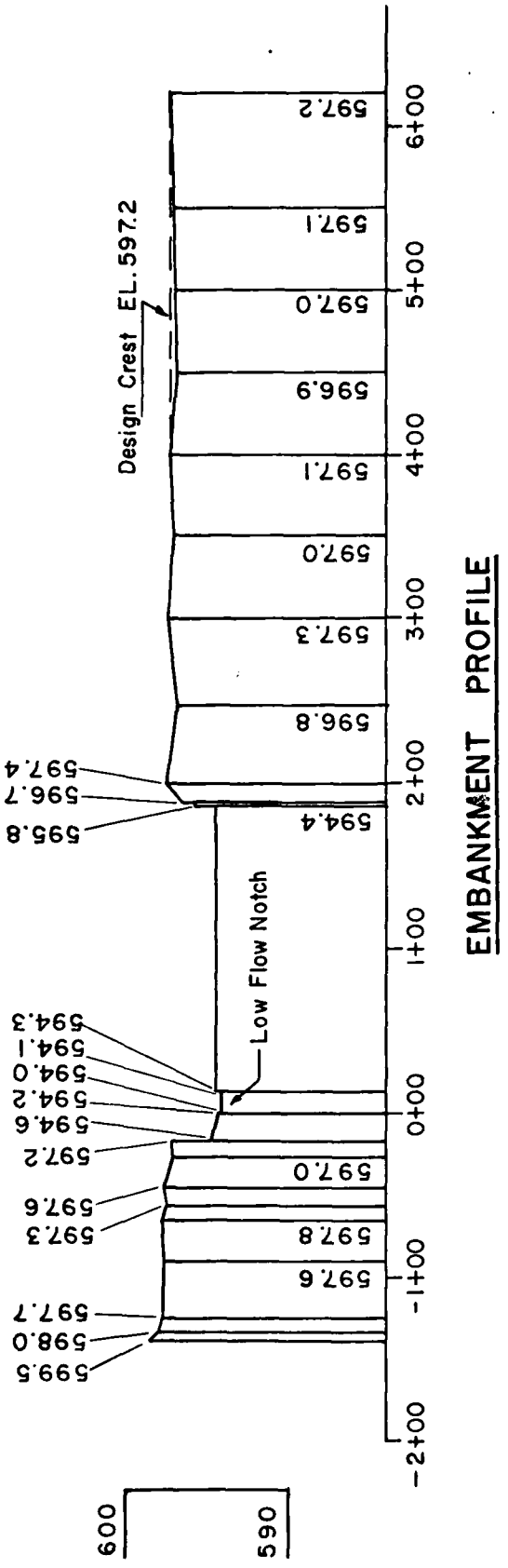
| | OBSERVATIONS AND REMARKS |
|---|---|
| INSTRUMENTATION<br>Monumentation | None. |
| Observation Wells | None. |
| Weirs | None. |
| Piezometers | None. |
| Staff Gauge | None. |
| Other | None. |
| RESERVOIR<br>Slopes | Left side steep, wooded.<br>Right side flat. |
| Sedimentation | Reservoir silted up. Maximum depth about 6 feet. Large areas with only 1 or 2 feet of water at normal pool. |
| Watershed Description | Mostly wooded. |
| DOWNSTREAM CHANNEL<br>Condition | Wooded natural stream, narrow valley parallelling Route 34 and railroad. |
| Slopes | Stable. |
| Approximate Population | Over hundred. |
| No. Homes | Paper mill, Route 34, deer lodge, and Mt. Holly Springs. |

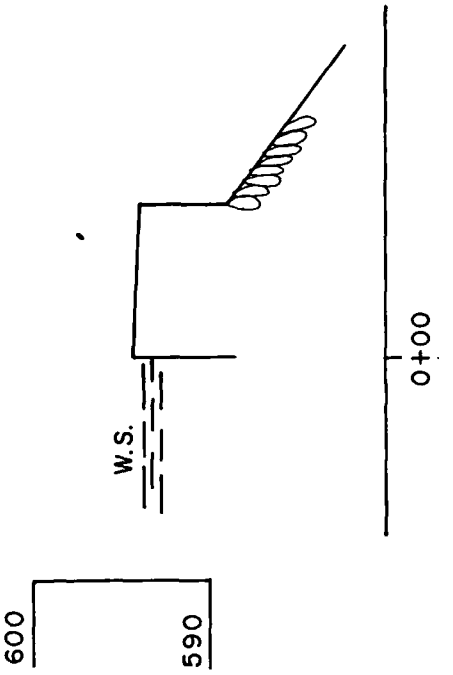



# UPPER MT. HOLLY DAM
# PA-00583
## INSPECTION SURVEY

SURVEYED 10-16 80

PLATE A-I




# UPPER MT. HOLLY DAM
# PA - 00583

INSPECTION SURVEY

SURVEYED 10-16-80

PLATE A-II

# APPENDIX B

## CHECK LIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 21-001 NDI NO. PA-00 583

NAME OF DAM Upper Mt. Holly Dam

| ITEM | REMARKS |
|---|---|
| AS-BUILT DRAWINGS | None. |
| REGIONAL VICINITY MAP | U.S.G.S. Quadrangle - Mt. Holly Springs, Pa. See Plate II, Appendix E |
| CONSTRUCTION HISTORY | Constructed in 1855. Breached 5 times. Rebuilt and repaired several times. Auxiliary spillway built in 1919 and back-filled in 1942. Spillway gunited in 1952. |
| GENERAL PLAN OF DAM | See Plate III, Appendix E. |
| TYPICAL SECTIONS OF DAM | Plate III, Appendix E. Drawings of 1922. Never repaired in accordance with plans. No later plans available. |
| OUTLETS:<br>PLAN<br>DETAILS<br>CONSTRAINTS<br>DISCHARGE RATINGS | No plans. |

NDI NO. PA-00 583

## ENGINEERING DATA

| ITEM | REMARKS |
|---|---|
| RAINFALL & RESERVOIR RECORDS | No records. |
| DESIGN REPORTS | None. |
| GEOLOGY REPORTS | None. |
| DESIGN COMPUTATIONS:<br>HYDROLOGY & HYDRAULICS<br>DAM STABILITY<br>SEEPAGE STUDIES | None. |
| MATERIALS INVESTIGATIONS:<br>BORING RECORDS<br>LABORATORY<br>FIELD | None. |
| POST CONSTRUCTION SURVEYS OF DAM | Plans prepared in 1914 and 1922. Plans not used for reconstruction. Many inspection reports by PennDER. |
| BORROW SOURCES | Unknown. |
| | |

ENGINEERING DATA

| ITEM | REMARKS |
|---|---|
| MONITORING SYSTEMS | None. |
| MODIFICATIONS | Gunited spillway in 1952, raising crest 3". Embankment near railroad rebuilt after 5 breaches. |
| HIGH POOL RECORDS | No records. |
| POST CONSTRUCTION ENGINEERING STUDIES & REPORTS | No reports. |
| PRIOR ACCIDENTS OR FAILURE OF DAM<br>Description:<br>Reports: | Dam had a low overflow section with planks near railroad. Breaches occurred in 1863, 1889, 1909, 1915 and 1919 in this area. |
| MAINTENANCE & OPERATION RECORDS | No records. |
| SPILLWAY PLAN, SECTIONS AND DETAILS | None. |

NDI NO. PA-00 583

ENGINEERING DATA

| ITEM | REMARKS |
|---|---|
| OPERATING EQUIPMENT, PLANS & DETAILS | No operable operating equipment. |
| CONSTRUCTION RECORDS | No records. |
| PREVIOUS INSPECTION REPORTS & DEFICIENCIES | Inspection reports by PennDER. Refer to Section 2 of this report for discussion. |
| MISCELLANEOUS | |

NDI NO. PA-00 583

# CHECK LIST
# HYDROLOGIC AND HYDRAULIC
# ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Woodland

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 594.0 Acre-Feet 61

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev.596.7 Acre-Feet 140

MAXIMUM DESIGN POOL: Elev. 597.3

TOP DAM: Elev. 596.7

SPILLWAY:

a. Elevation 594

b. Type Concrete, broad crested weir with sloping face and low flow notch.

c. Width 206'

d. Length --

e. Location Spillover Near left abutment.

f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 6' x 16' concrete arch tunnel with 5' x 5' timber gate.

b. Location Near left abutment.

c. Entrance inverts 584.9

d. Exit inverts 584.2

e. Emergency drawdown facilities 5' square timber gate.

HYDROMETEOROLOGICAL GAGES:

a. Type None.

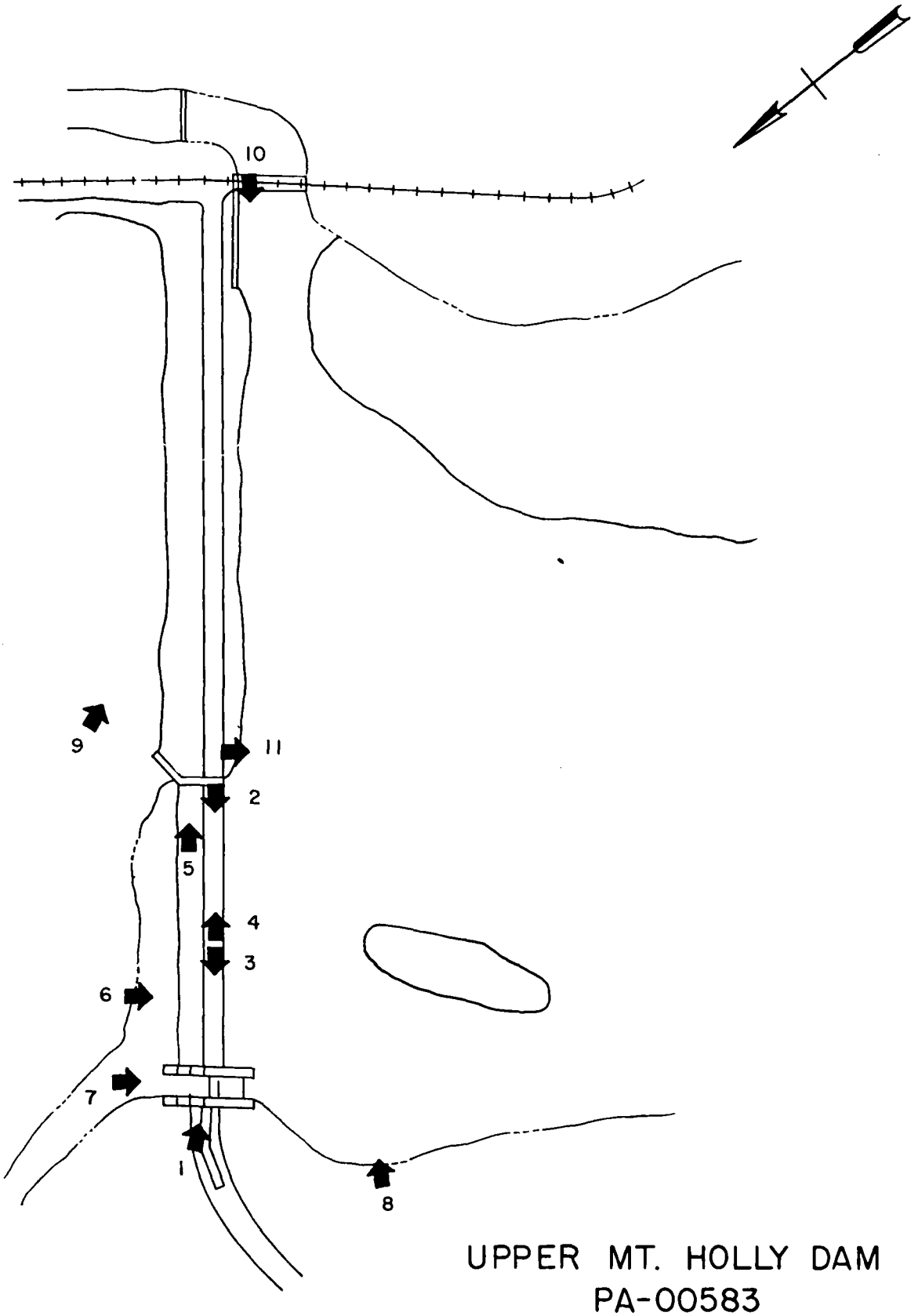
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 2018 cfs.

APPENDIX C

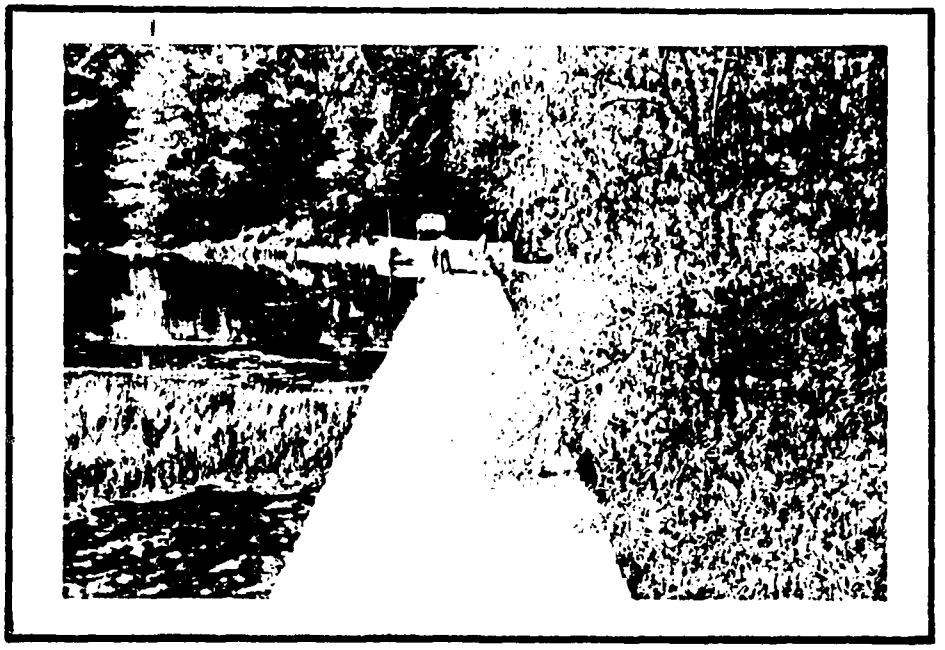
PHOTOGRAPHS



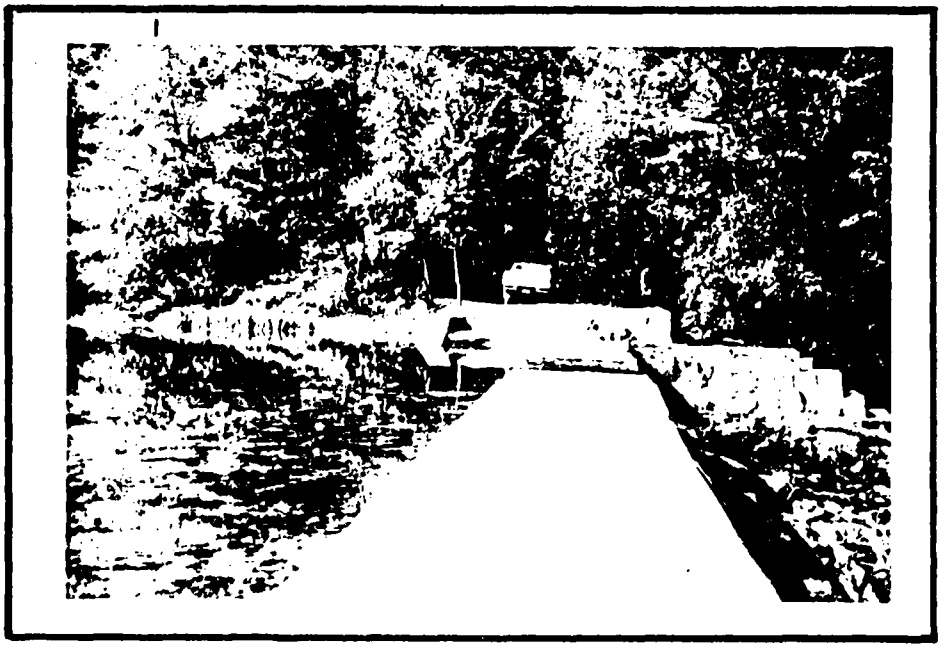

# UPPER MT. HOLLY DAM
# PA-00583

KEY MAP OF PHOTOGRAPHS

PLATE C-I



OVERVIEW OF SPILLWAY FROM RIGHT ABUTMENT - NO. 2

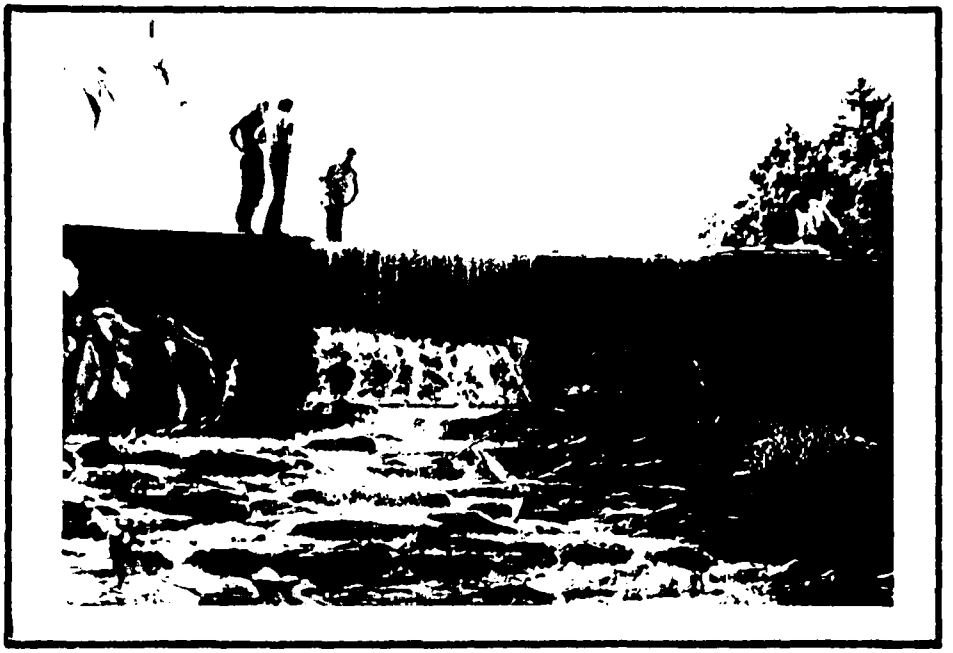


LEFT SPILLWAY ABUTMENT - NO. 3

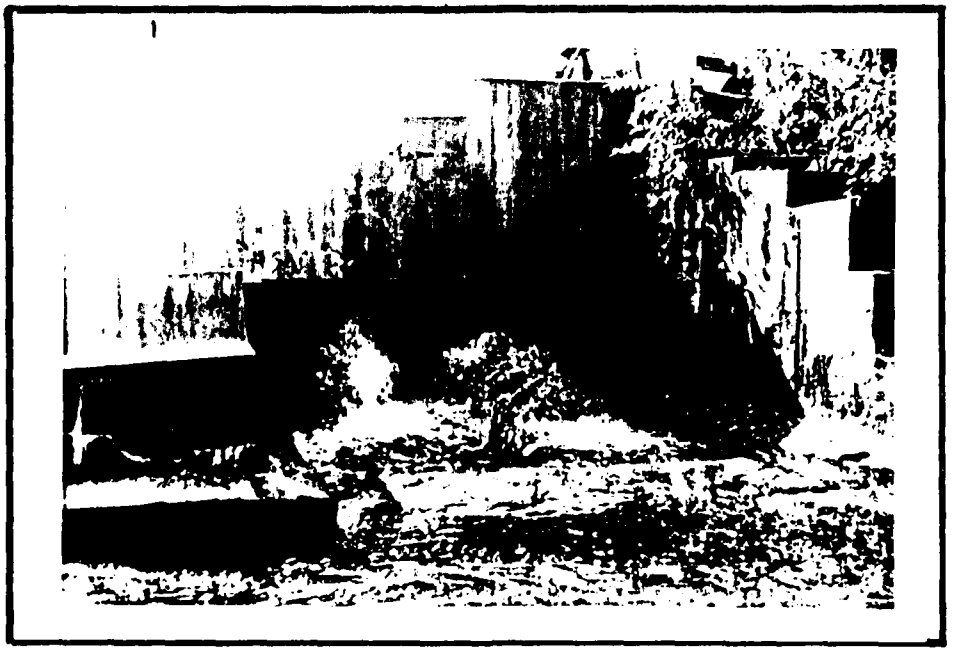
PA-00583
Plate C-11

DOWNSTREAM ROCK PROTECTION OF SPILLWAY - NO. 4

RIGHT SPILLWAY ABUTMENT - NO. 5



LOW FLOW SECTION OF SPILLWAY - NO. 6



DOWNSTREAM SIDE OUTLET STRUCTURE - NO. 7

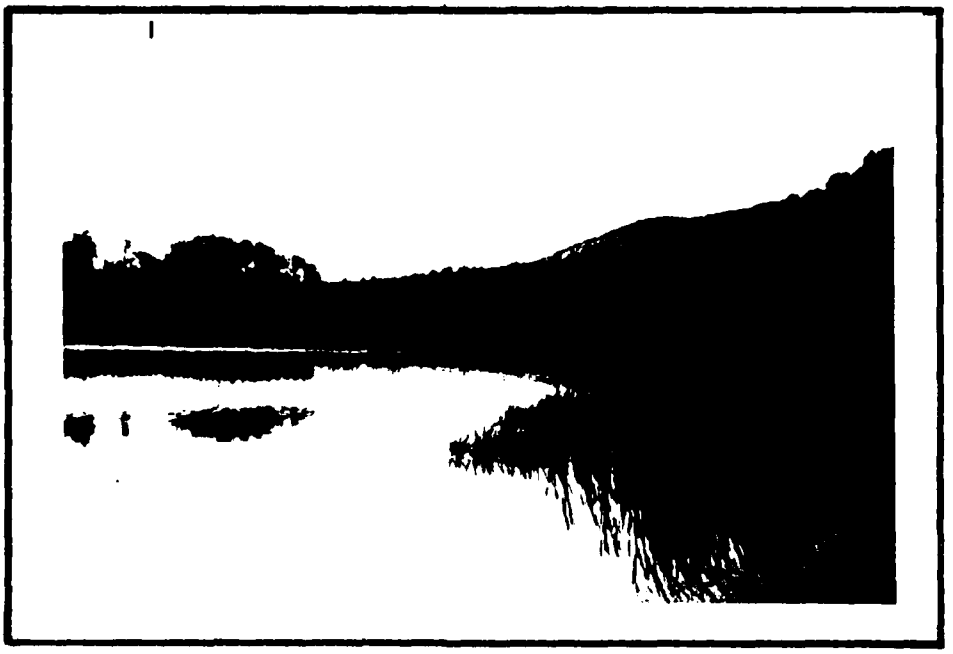
PA-00583
Plate C-IV

OVERVIEW SPILLWAY FROM LEFT RESERVOIR BANK - NO. 8

DOWNSTREAM SLOPE OF EMBANKMENT - NO. 9

PA-00583
Plate C-V

CHANNEL TO HEADRACE LOOKING UPSTREAM - NO. 10
NOTE: OVERGROWN EMBANKMENT



RESERVOIR OVERVIEW - NO. 11
NOTE: WEED GROWTH IN RESERVOIR

PA-00583
Plate C-VI

# APPENDIX D

# HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

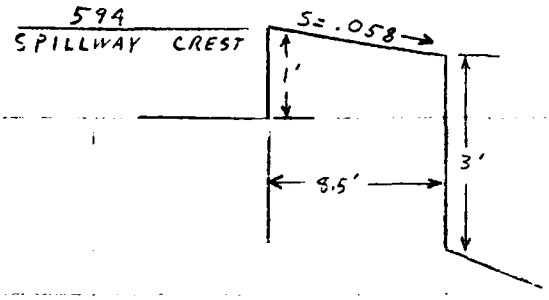
The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

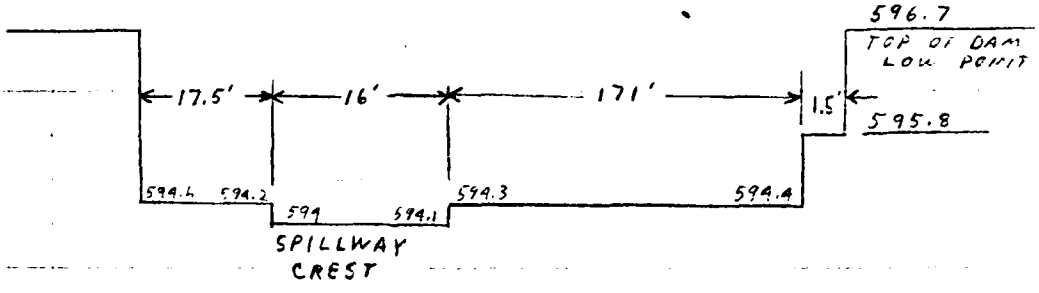
BY RLS DATE 10/30/80 **BERGER ASSOCIATES** SHEET NO. 1 OF 9
CHKD. BY DJR DATE 11/4/80 PROJECT D0590
SUBJECT UPPER MOUNT HOLLY DAM

# SPILLWAY RATING




BROADCRESTED WEIR WITH INCLINED CREST

C = 2.7 (ESTIMATED FROM KING'S HDBK.)




$$Q = C L_1 H_1^{3/2} + C L_2 H_2^{3/2} + C L_3 H_3^{3/2} + C L_4 H_4^{3/2}$$

$H_1 = 596.7 - ((594.6+594.2)/2) = 2.3'$ $\quad L_1 = 17.5'$

$H_2 = 596.7 - ((594+594.1)/2) = 2.65'$ $\quad L_2 = 16'$

$H_3 = 596.7 - ((594.3+594.4)/2) = 2.35'$ $\quad L_3 = 171'$

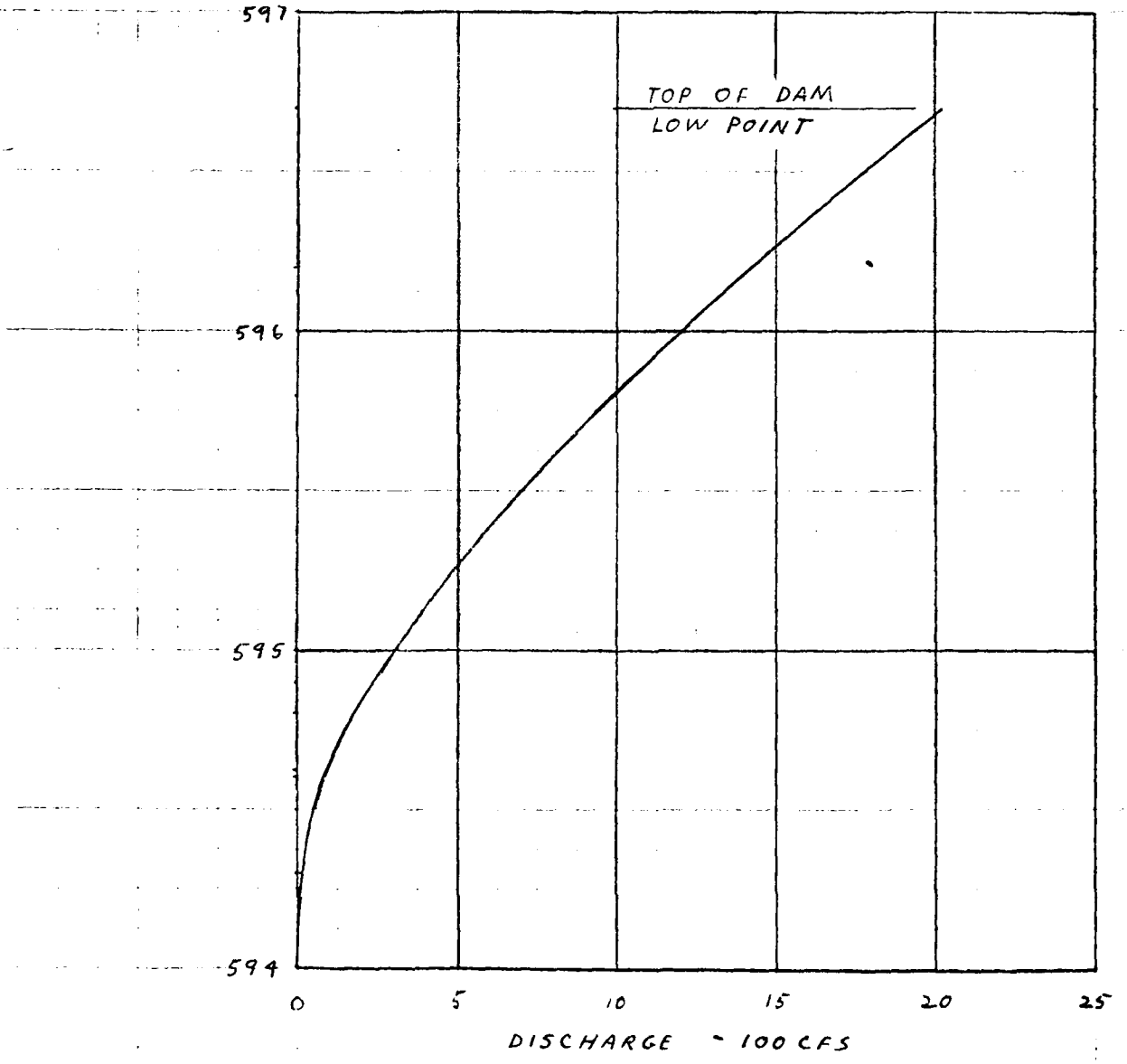
$H_4 = 596.7 - 595.8 = 0.9'$ $\quad L_4 = 1.5'$

$$Q = 2.7 \times 17.5 \times (2.3)^{1.5} + 2.7 \times 16 \times (2.65)^{1.5} + 2.7 \times 171 \times (2.35)^{1.5} + 2.7 \times 1.5 \times (0.9)^{1.5}$$

$$= 2018 \text{ CFS}$$

BY BLS DATE 10/30/80 **BERGER ASSOCIATES** SHEET NO. 2 OF 9
CHKD. BY DJE DATE 11/4/80 PROJECT D0590
SUBJECT UPPER MOUNT HOLLY DAM

## SPILLWAY RATING CURVE



BY RLS DATE 10/31/80 **BERGER ASSOCIATES** SHEET NO. 3 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT UPPER MOUNT HOLLY DAM

## DISCHARGE THRU OUTLET WORKS

CONCRETE ARCH TUNNEL 6'x16' WITH 5'x5' WOODEN GATE

UPSTREAM INVERT = 584.9

$Q = C A \sqrt{2gH}$ $C = 0.6$ (KING'S HDBK.)

AT POOL ELEV. 594

$H = 594 - 587.4 = 6.6'$

$Q = 0.6 \times 5 \times 5 \times (2 \times 32.2 \times 6.6)^{0.5}$

$= 309$ CFS

AT LOW POOL ELEV 590

$H = 590 - 587.4 = 2.6'$

$Q = 0.6 \times 5 \times 5 \times (2 \times 32.2 \times 2.6)^{0.5}$

$= 194$ CFS

BY RLS DATE 2/25/81 **BERGER ASSOCIATES** SHEET NO. 4 OF 9
CHKD. BY DATE PROJECT D0520
SUBJECT UPPER MOUNT HOLLY DAM

## EMBANKMENT RATING

$Q = C L H^{3/2}$ C = 2.7 (KING'S HDBK.)

AT ELEV 597

2.7 x 5 x (.15)^1.5 = 1
2.7 x 37 x (.1)^1.5 = 3
2.7 x 75 x (.05)^1.5 = 2
2.7 x 19 x (.2)^1.5 = 4
2.7 x 14 x (.1)^1.5 = 1 Σ = 11 CFS

AT ELEV 597.5

2.7 x 10 x (.4)^1.5 = 7
2.7 x 17 x (.25)^1.5 = 6
2.7 x 11 x (.45)^1.5 = 9
2.7 x 50 x (.4)^1.5 = 34
2.7 x 100 x (.45)^1.5 = 82
2.7 x 50 x (.35)^1.5 = 28
2.7 x 150 x (.5)^1.5 = 143
2.7 x 70 x (.35)^1.5 = 39
2.7 x 4 x (.1)^1.5 = -
2.7 x 6 x (.1)^1.5 = 1
2.7 x 19 x (.7)^1.5 = 30
2.7 x 26 x (.35)^1.5 = 15
2.7 x 24 x (.35)^1.5 = 13 Σ = 407 CFS

AT ELEV 598

2.7 x 10 x (.9)^1.5 = 23
2.7 x 20 x (.7)^1.5 = 32
2.7 x 10 x (.55)^1.5 = 11
2.7 x 10 x (.45)^1.5 = 8
2.7 x 23 x (.3)^1.5 = 10
2.7 x 33 x (.25)^1.5 = 11
2.7 x 11 x (.15)^1.5 = 2
2.7 x 11 x (.95)^1.5 = 28
2.7 x 50 x (.9)^1.5 = 115
2.7 x 100 x (.95)^1.5 = 250
2.7 x 50 x (.85)^1.5 = 106
2.7 x 150 x (1)^1.5 = 405
2.7 x 70 x (.85)^1.5 = 148
2.7 x 19 x (1.2)^1.5 = 67
2.7 x 30 x (.8)^1.5 = 58
2.7 x 42 x (.6)^1.5 = 53 Σ = 1327 CFS

## EMBANKMENT RATING (CONT.)

AT ELEV 598.5

$2.7 \times 10 \times (1.4)^{1.5} = 45$
$2.7 \times 20 \times (1.2)^{1.5} = 71$
$2.7 \times 10 \times (1.05)^{1.5} = 29$
$2.7 \times 10 \times (.95)^{1.5} = 25$
$2.7 \times 23 \times (.8)^{1.5} = 44$
$2.7 \times 33 \times (.75)^{1.5} = 58$
$2.7 \times 11 \times (.65)^{1.5} = 16$
$2.7 \times 11 \times (1.45)^{1.5} = 52$
$2.7 \times 50 \times (1.4)^{1.5} = 224$
$2.7 \times 100 \times (1.45)^{1.5} = 471$
$2.7 \times 50 \times (1.35)^{1.5} = 212$
$2.7 \times 150 \times (1.5)^{1.5} = 744$
$2.7 \times 70 \times (1.35)^{1.5} = 297$
$2.7 \times 19 \times (1.7)^{1.5} = 113$
$2.7 \times 30 \times (1.3)^{1.5} = 120$
$2.7 \times 45 \times (105)^{1.5} = 131$ $\Sigma = 2652$

AT ELEV 599 $\Sigma = 4269$

AT ELEV 599.5 $\Sigma = 6130$

AT ELEV 600 $\Sigma = 8208$

AT ELEV 601 $\Sigma = 12931$

AT ELEV 603 $\Sigma = 24310$

AT ELEV 605 $\Sigma = 37861$

AT ELEV 608 $\Sigma = 61622$

## MAXIMUM KNOWN FLOOD AT DAMSITE

THERE ARE NO RECORDS OF POOL LEVELS FOR THIS DAM. BASED ON THE RECORDS OF THE GAGING STATION FOR YELLOW BREECHES CREEK AT NEARBY CAMP HILL, PA. (D.A. = 216 SQ. MI.) THE MAXIMUM DISCHARGE AT THE GAGE OCCURRED IN SEPTEMBER, 1975 WHEN A DISCHARGE OF 19300 CFS WAS OBSERVED. THE MAXIMUM INFLOW TO UPPER MOUNT HOLLY DAM IS ESTIMATED TO BE:

$$Q = \left(\frac{44.43}{216}\right)^{0.8} \times 19300$$

$$= 5447 \text{ CFS}$$

## DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 140 ACRE-FEET
MAXIMUM HEIGHT = 13 FEET
SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

BOROUGH OF MOUNT HOLLY SPRINGS IS LOCATED ALONG THE DOWNSTREAM CHANNEL.
USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF IN THE RANGE OF ONE-HALF PMF TO THE PROBABLE MAXIMUM FLOOD.

## UPSTREAM RESERVOIR

LAUREL LAKE DAM

D.A. = 23.57 SQ. MI.

(DATA FROM PHASE I INSPECTION REPORT)

250' LONG, 25' HIGH CONCRETE GRAVITY DAM

SPILLWAY = 200' LONG OGEE SECTION C = 3.8

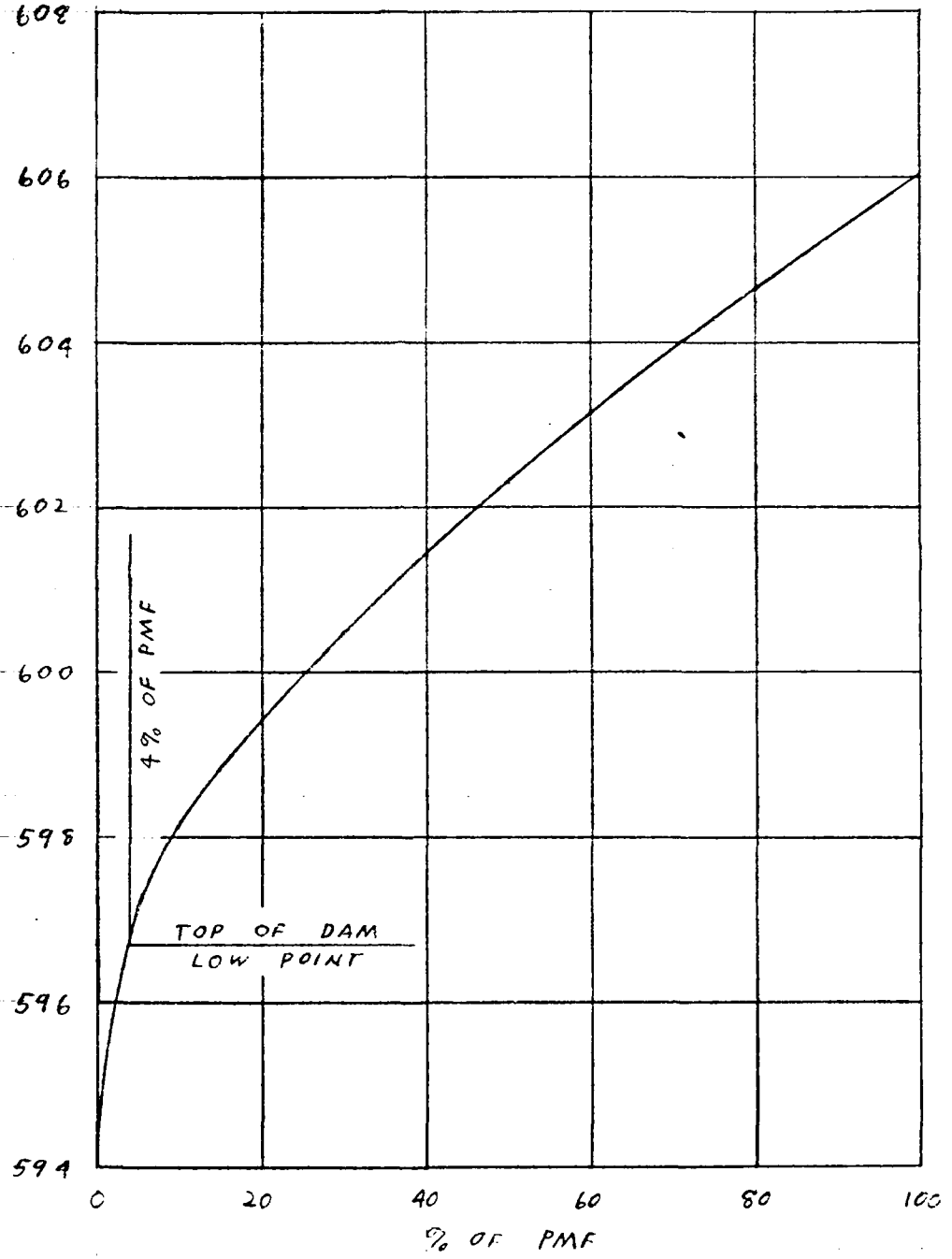
SPILLWAY ELEV. = 774.5
TOP OF DAM ELEV. = 786.0

NORMAL STORAGE = 160 AC-FT
MAXIMUM STORAGE = 896 AC-FT

MAXIMUM SPILLWAY CAPACITY = 32720 CFS

BY RLS DATE 2/27/51 **BERGER ASSOCIATES** SHEET NO. 8 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT UPPER MOUNT HOLLY DAM

## SPILLWAY CAPACITY CURVE



BY RLS DATE 2/27/81 **BERGER ASSOCIATES** SHEET NO. 9 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT UPPER MOUNT HOLLY DAM

## BREACH ASSUMPTIONS

BREACH WIDTH = 50'

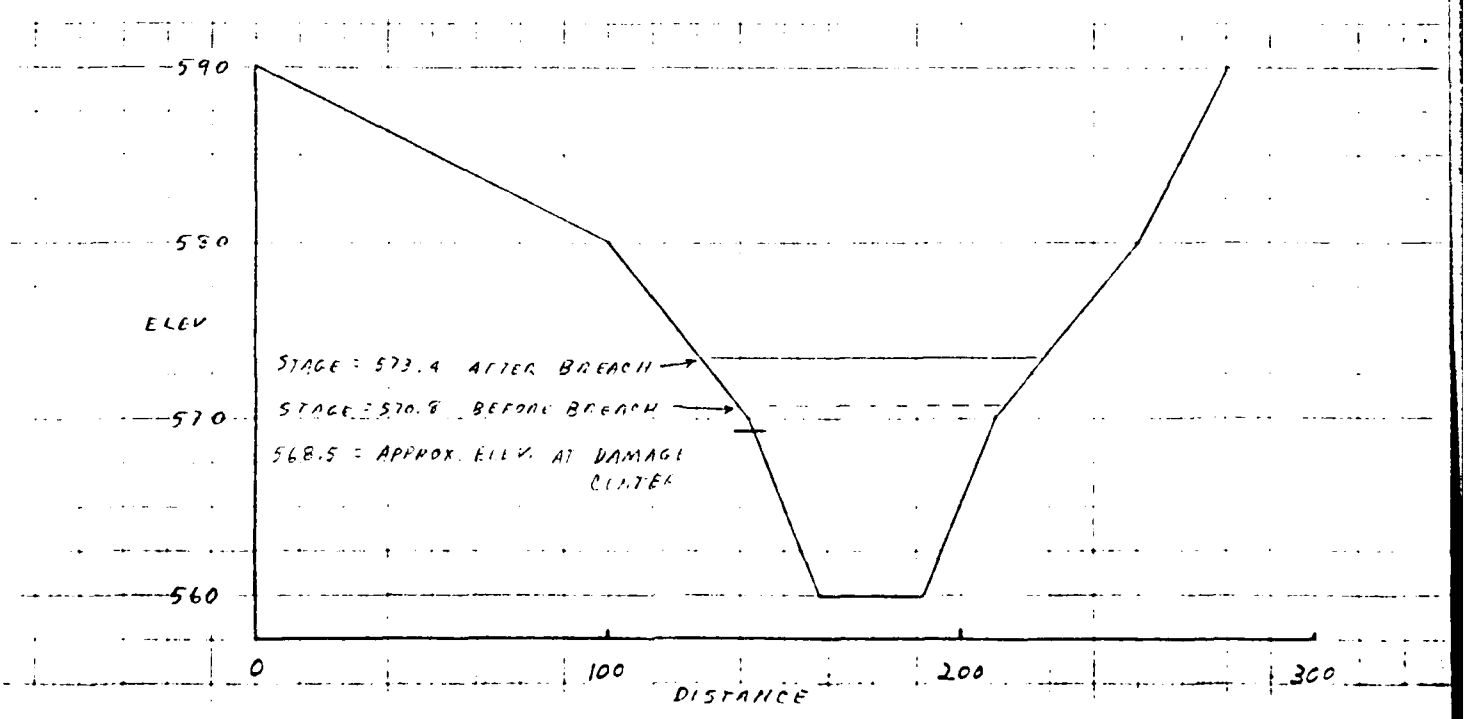
SIDE SLOPES (EARTH EMBANKMENT) = 1:1

FAILURE TIME (EARTH EMBANKMENT) =
BETWEEN 15 MIN. AND 2 HR.
USE: .25 HR., .5 HR., 1 HR., 2 HR.

POOL LEVEL AT FAILURE: EARTH EMBANKMENT
SAY 0.5 FT. OVER TOP OF DAM

UPSTREAM RESERVOIR:
LAUREL LAKE DAM = NOT OVERTOPPED BY 6% PMF
WILL NOT BREACH

SECTION AT DAMAGE CENTER
4300' DOWNSTREAM OF DAM



# HYDROLOGY AND HYDRAULIC ANALYSIS
# DATA BASE

NAME OF DAM: Upper Mt. Holly Dam RIVER BASIN: Susquehanna

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.6 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

| STATION | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| STATION DESCRIPTION | | LAUREL LAKE | LAUREL LAKE DAM | UPPER MOUNT HOLLY RESERVOIR | UPPER MOUNT HOLLY DAM |
| DRAINAGE AREA (SQUARE MILES) | | 23.57 | | 20.86 | |
| CUMULATIVE DRAINAGE AREA (SQUARE MILE) | | 23.57 | 23.57 | 44.43 | 44.43 |
| ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2] | 6 HOURS | 98 | | 98 | |
| | 12 HOURS | 107.5 | | 107.5 | |
| | 24 HOURS | 117 | | 117 | |
| | 48 HOURS | 130 | | 130 | |
| | 72 HOURS Zone 6 | | | | |
| SNYDER HYDROGRAPH PARAMETERS | ZONE[3] | 15A | | 15A | |
| | $C_p / C_t$[4] | .54/1.15 | | .54/1.15 | |
| | L (MILES)[5] | 10.33 | | 7.88 | |
| | $L_{ca}$ (MILES)[5] | 4.92 | | 3.90 | |
| | $T_p = C_t (L \cdot L_{ca})^{0.3}$ (Hours) | 3.74 | | 3.21 | |
| SPILLWAY DATA | CREST LENGTH (FT.) | | 200 | | 206 |
| | FREEBOARD (FT.) | | 11.5 | | 2.7 |
| | DISCHARGE COEFFICIENT | | 3.8 | | 2.7 |
| | EXPONENT | | 1.5 | | 1.5 |
| | ELEVATION | | 774.5 | | 594 |
| AREA[6] (ACRES) | NORMAL POOL | 774.5 = 25[7] | | 594 = 20 | |
| | ELEV. _____ | 780 = 40 | | 600 = 72 | |
| | ELEV. _____ | 790 = 73 | | 610 = 104 | |
| STORAGE (ACRE-FEET) | NORMAL POOL[7] | 774.5 = 160 | | 594 = 61 | |
| | ELEV. _____[8] | 755.3 = 0 | | 584.8 = 0 | |
| | ELEV. _____[8] | | | | |
| | ELEV. _____[8] | | | | |

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients ($C_p$ and $C_t$).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.

$L_{ca}$ = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

(8) Computed by conic method.

TABLE NO. 1

COMPARISON OF WATER SURFACE ELEVATIONS

UPPER MT. HOLLY DAM

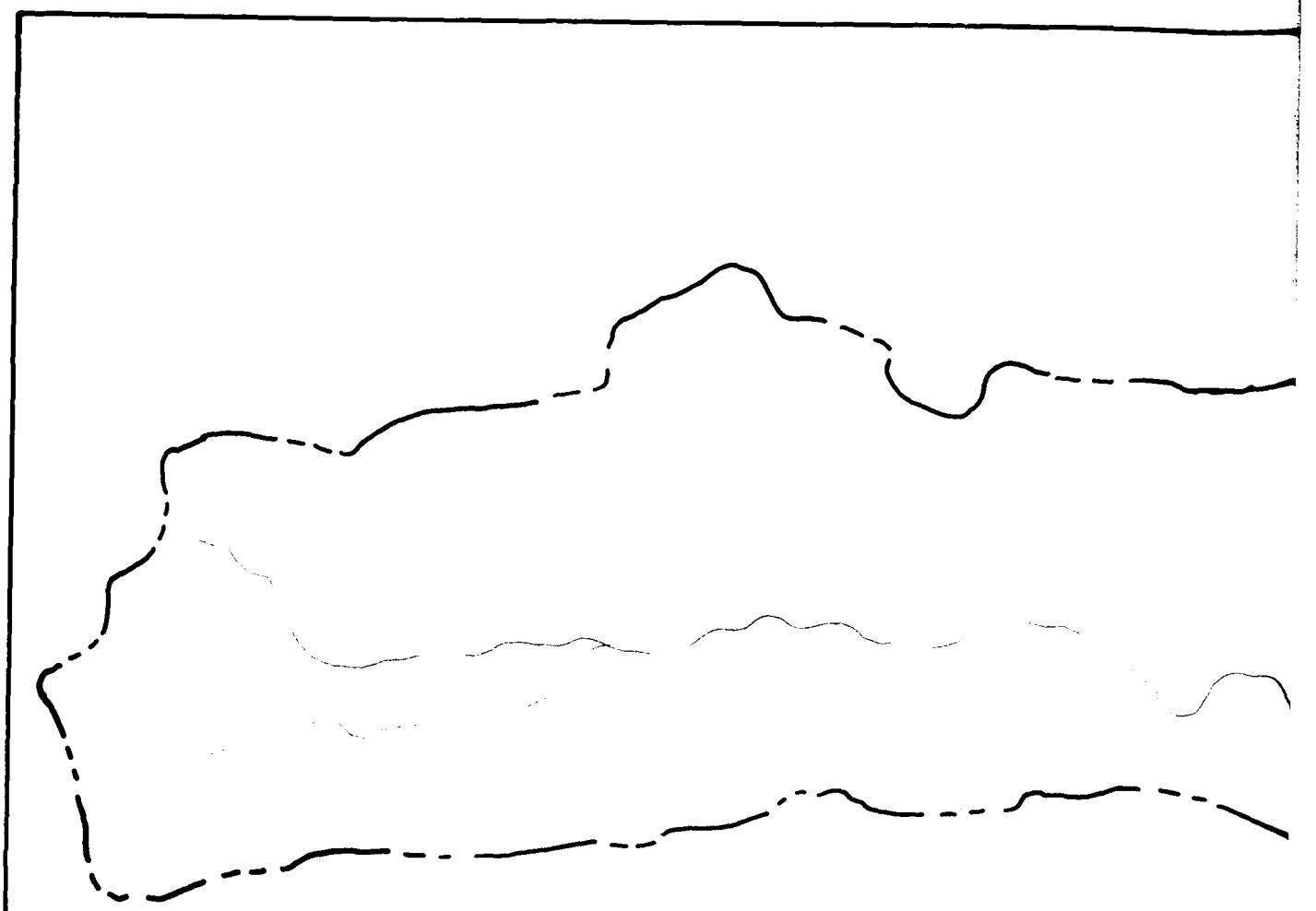
PMF = 68,135 cfs SDF = 32,938 cfs

Crest Elevation (Low Point) - 596.7 Spillway Elevation - 594

| | STAGE | CREST OF DAM ELEVATION | DEPTH | 4300' D/S OF DAM* ELEVATION |
|---|---|---|---|---|
| A. | At Low Point in Embankment Crest | 596.7 | 0 | 568.3 |
| B. | 6% PMF Overtopping No Breach | 597.43 | .73 | 570.8 |
| C. | 6% PMF Overtopping (.25 Hour Breach) | 597.27 | .57 | 573.4 |
| D. | 6% PMF Overtopping (2 Hour Breach) | 597.31 | .61 | 572.0 |

*Restaurant located about 4,300 feet downstream of Upper Mt. Holly Dam. Considered to be damage center. (This area is just upstream of the residential portion of Mt. Holly Springs.)

Condition C: (Time refers to elapsed time after start of storm). Time to reach breach elevation 598.2 at dam = 43.0 Hours. Water level 4300' downstream prior to breach = 570.8. Duration of breach = .25 Hours. Time for breach to peak 4300' downstream = .5 Hours. Peak elevation 4300' downstream due to breach = 573.4. Rate of increase in water level = 2.6' in 30 Minutes.



# DRAINAGE AREA MAP

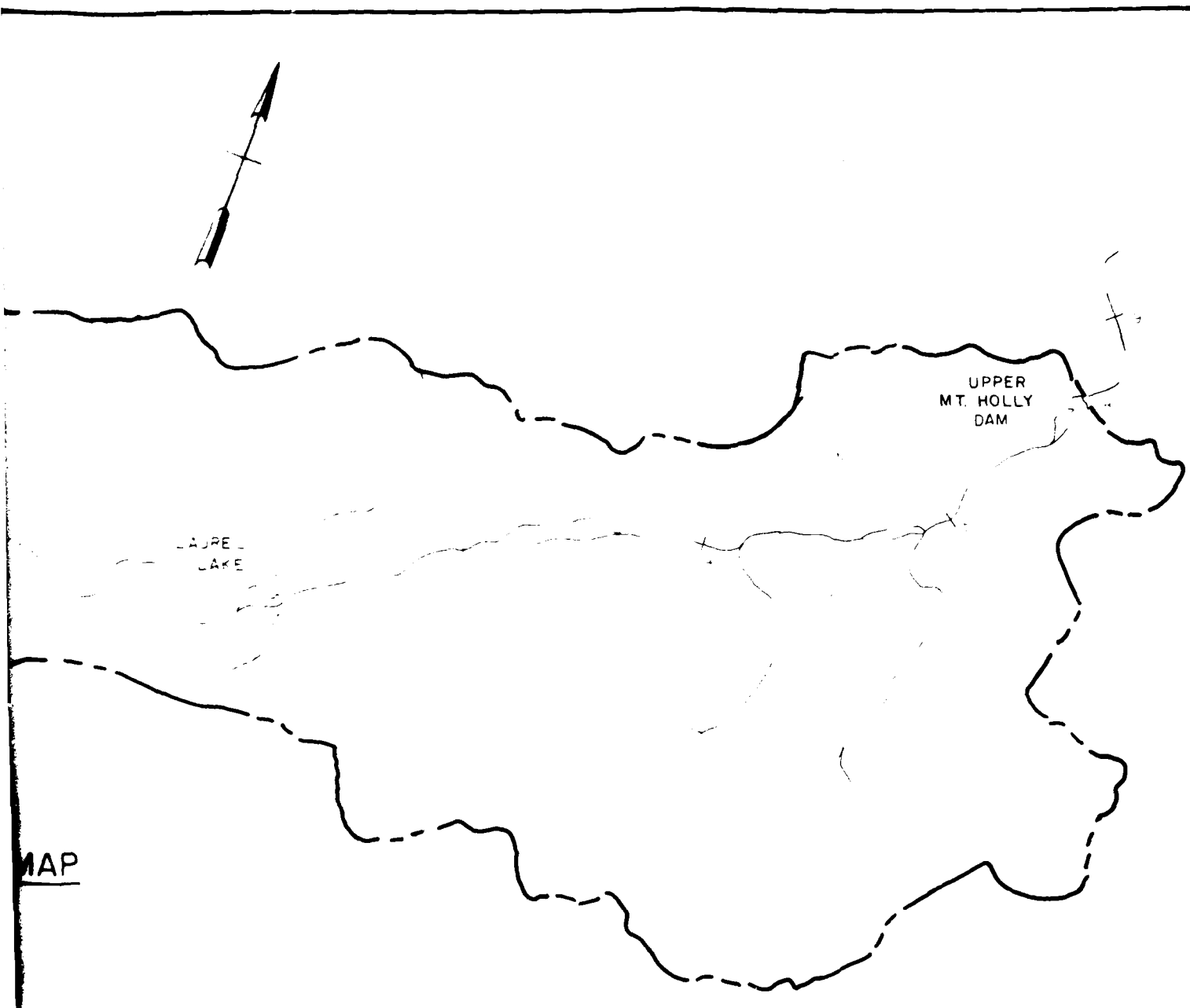
SCALE 1" = 1 MILE

DRAINAGE AREA

SUB-DRAINAGE AREA

STREAMS

9 STREAM STATION IDENTIFI




MAP

AREA

GE AREA

TION IDENTIFICATION

UPPER MT. HOLLY DAM
PA - 00538

PLATE D-1

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
*******************************
     1          A1                UPPER MOUNT HOLLY DAM    ****    MOUNTAIN CREEK
     2          A2                BOROUGH OF MOUNT HOLLY SPRINGS, CUMBERLAND COUNTY, PA.
     3          A3                NDI # PA-00533      PA DER # 21-1
     4          B    300      0      15       0       0       0       0       0      -4       0
     5          B1     5
     6          J      1      9       1
     7          J1     1    .75      .5     .25     .15      .1     .05     .03     .01
     8          K              1                                       1
     9          K1                INFLOW HYDROGRAPH - LAUREL LAKE SUBAREA
    10          M      1      1   23.57           44.43
    11          P           23.6      98   107.5     117     130
    12          T                                                       1     .05
    13          W   3.74    .54
    14          X   -1.5   -.05       2
    15          K      1      2                                       1
    16          K1                RESERVOIR ROUTING - LAUREL LAKE
    17          Y                              1
    18          Y1     1                                             160      -1
    19          Y4 774.5  775.5   776.5   777.5   778.5     780     782     784     786     788
    20          Y5     0    760    2150    3950    6080   10078   16590   24189   32720   42090
    21          $A     0     25      30    35.5      40    45.5      52      59    66.5    73.4
    22          $E 755.3  774.5   776.5   778.5     780     782     784     786     788     790
    23          $$ 774.5
    24          $D   786   3.05     1.5     150
    25          K      1      3                                       1
    26          K1                ROUTING THRU REACH 2 - 3
    27          Y                              1
    28          Y1     1
    29          Y6    .1    .07      .1     700     730    7800   .0064
    30          Y7     0    730     100     720     200     710     850     700     860     700
    31          Y7  1100    710    1300     720    1600     730
    32          K      1      4                                       1
    33          K1                ROUTING THRU REACH 3 - 4
    34          Y                              1
    35          Y1     1
    36          Y6    .1    .07      .1     660     690   10300   .0039
    37          Y7     0    690     100     680     150     670     300     660     310     660
    38          Y7   950    670    1120     680    1200     690
    39          K      1      5                                       1
    40          K1                ROUTING THRU REACH 4 - 5
    41          Y                              1
    42          Y1     1
    43          Y6    .1    .07      .1     610     640   10600   .0047
    44          Y7     0    640     100     630     200     620     700     610     710     610
    45          Y7   740    620     770     630     800     640
    46          K              6                                       1
    47          K1                INFLOW HYDROGRAPH - UPPER MOUNT HOLLY SUBAREA
    48          M      1      1   20.86           44.43
    49          P           23.6      98   107.5     117     130
    50          T                                                       1     .05
  1 51          W   3.21    .54
    52          X   -1.5   -.05       2
    53          K      2      7                                       1
```

```
 54            K1                COMBINE HYDROGRAPHS AT UPPER MOUNT HOLLY DAM
 55            K     1       8                                          1
 56            K1                RESERVOIR ROUTING - THRU UPPER MOUNT HOLLY DAM
 57            Y                                 1
 58            Y1    1                                                 61     -1
 59            Y4   594    594.5     595    595.5     596    596.7     597   597.5     598   598.5
 60            Y4   599    599.5     600      601     603      605     608
 61            Y5     0       42     304      699    1193     2018    2425    3532    5222    7371
 62            Y5  9864    12649   15697    22490   38483    57217   89705
 63            $A     0       20      72      104
 64            $E 584.8      594     600      610
 65            $$   594
 66            $D 596.7
 67            K     99
1                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                ROUTE HYDROGRAPH TO           3
                                ROUTE HYDROGRAPH TO           4
                                ROUTE HYDROGRAPH TO           5
                                RUNOFF HYDROGRAPH AT          6
                                COMBINE  2 HYDROGRAPHS AT     7
                                ROUTE HYDROGRAPH TO           8
                                END OF NETWORK

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  01 APR 80
 **********************************

 RUN  DATE* 81/02/26.
      TIME* 05.59.06.
```

UPPER MOUNT HOLLY DAM **** MOUNTAIN CREEK
BOROUGH OF MOUNT HOLLY SPRINGS, CUMBERLAND COUNTY, PA.
NDI # PA-00583 PA DER # 21-1

JOB SPECIFICATION

| NQ | NHR | NMIN | IDAY | IHR | ININ | METRC | IPLT | IPRT | NSTAN |
|---|---|---|---|---|---|---|---|---|---|
| 300 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | -4 | 0 |
| | | | JOPER | NWT | LROPT | TRACE | | | |
| | | | 5 | 0 | 0 | 0 | | | |

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= 1.00 .75 .50 .25 .15 .10 .05 .03 .01

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LAUREL LAKE SUBAREA

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 23.57 | 0.00 | 44.43 | 0.00 | 0.000 | 0 | 0 | 0 |

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 23.60 | 98.00 | 107.50 | 117.00 | 130.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .846

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA

TP= 3.74 CP= .54 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.73 HOURS, CP= .54 VOL= .99

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37. | 139. | 285. | 460. | 655. | 866. | 1089. | 1321. | 1550. | 1755. |
| 1927. | 2065. | 2170. | 2238. | 2266. | 2237. | 2145. | 2029. | 1920. | 1816. |
| 1718. | 1625. | 1538. | 1455. | 1376. | 1302. | 1232. | 1165. | 1102. | 1043. |
| 987. | 933. | 883. | 835. | 790. | 748. | 707. | 669. | 633. | 599. |
| 567. | 536. | 507. | 480. | 454. | 429. | 406. | 384. | 363. | 344. |
| 325. | 308. | 291. | 275. | 261. | 247. | 233. | 221. | 209. | 197. |
| 187. | 177. | 167. | 158. | 150. | 142. | 134. | 127. | 120. | 113. |
| 107. | 101. | 96. | 91. | 86. | 81. | 77. | 73. | 69. | 65. |
| 62. | 58. | 55. | 52. | 49. | 47. | 44. | 42. | 40. | 37. |
| 35. | 33. | 32. | 30. | 28. | 27. | 25. | 24. | 23. | 21. |

0 END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | SUM | 25.97 | 23.48 | 2.49 | 1423079. |
| | | | | | | | | | | ( 660.) | ( 596.) | ( 63.) | (40297.11) |

********** ********** ********** ********** **********

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - LAUREL LAKE

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 160. | -1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STAGE | 774.50 | 775.50 | 776.50 | 777.50 | 778.50 | 780.00 | 782.00 | 784.00 | 786.00 | 788.00 |
| FLOW | 0.00 | 760.00 | 2150.00 | 3950.00 | 6080.00 | 10078.00 | 16590.00 | 24189.00 | 32720.00 | 42090.00 |
| SURFACE AREA= | 0. | 25. | 30. | 36. | 40. | 46. | 52. | 59. | 67. | 73. |
| CAPACITY= | 0. | 160. | 215. | 280. | 337. | 422. | 520. | 631. | 756. | 896. |
| ELEVATION= | 755. | 775. | 777. | 779. | 780. | 782. | 784. | 786. | 788. | 790. |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 774.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 786.0 | 3.1 | 1.5 | 150. |

PEAK OUTFLOW IS 36575. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 27426. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 18285. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 9137. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 5479. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 3650. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 1822. AT TIME 43.50 HOURS

K OUTFLOW IS 1094. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 361. AT TIME 43.75 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 3 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 700.0 | 730.0 | 7800. | .00640 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 730.00 100.00 720.00 200.00 710.00 850.00 700.00 860.00 700.00
1100.00 710.00 1300.00 720.00 1600.00 730.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 22.69 | 85.12 | 187.27 | 329.16 | 510.78 | 732.13 | 987.35 | 1257.44 | 1540.91 |
| | 1837.78 | 2148.04 | 2471.69 | 2808.99 | 3163.15 | 3535.16 | 3925.03 | 4332.76 | 4758.35 | 5201.79 |
| OUTFLOW | 0.00 | 192.38 | 1122.34 | 3212.37 | 6814.52 | 12242.90 | 19786.34 | 31286.85 | 46026.29 | 63155.61 |
| | 82631.96 | 104428.53 | 128530.21 | 154873.49 | 183454.83 | 214433.76 | 247839.40 | 283704.36 | 322063.25 | 362951.98 |
| STAGE | 700.00 | 701.58 | 703.16 | 704.74 | 706.32 | 707.89 | 709.47 | 711.05 | 712.63 | 714.21 |
| | 715.79 | 717.37 | 718.95 | 720.53 | 722.11 | 723.68 | 725.26 | 726.84 | 728.42 | 730.00 |
| FLOW | 0.00 | 192.38 | 1122.34 | 3212.37 | 6814.52 | 12242.90 | 19786.34 | 31286.85 | 46026.29 | 63155.61 |
| | 82631.96 | 104428.53 | 128530.21 | 154873.49 | 183454.83 | 214433.76 | 247839.40 | 283704.36 | 322063.25 | 362951.98 |

MAXIMUM STAGE IS 711.6

MAXIMUM STAGE IS 710.5

MAXIMUM STAGE IS 709.1

MAXIMUM STAGE IS 707.0

MAXIMUM STAGE IS 705.7

MAXIMUM STAGE IS 704.9

MAXIMUM STAGE IS 703.6

MAXIMUM STAGE IS 703.0

MAXIMUM STAGE IS 701.8

**********  **********  **********  **********  **********

**********  **********  **********  **********  **********

HYDROGRAPH ROUTING

ROUTING THRU REACH 3 - 4

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 660.0 | 690.0 | 10300. | .00390 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 690.00 100.00 680.00 150.00 670.00 300.00 660.00 310.00 660.00
950.00 670.00 1120.00 680.00 1200.00 690.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 27.02 | 100.61 | 220.77 | 387.50 | 600.80 | 860.67 | 1159.65 | 1473.46 | 1800.24 |
| | 2139.99 | 2492.71 | 2858.39 | 3236.92 | 3626.58 | 4026.85 | 4437.73 | 4859.23 | 5291.33 | 5734.04 |
| OUTFLOW | 0.00 | 136.05 | 786.24 | 2242.54 | 4748.53 | 8521.67 | 13761.91 | 21746.29 | 31962.67 | 43807.78 |
| | 57241.17 | 72234.86 | 88769.81 | 106854.19 | 126504.35 | 147660.89 | 170308.39 | 194437.22 | 220041.47 | 247117.88 |
| STAGE | 660.00 | 661.58 | 663.16 | 664.74 | 666.32 | 667.89 | 669.47 | 671.05 | 672.63 | 674.21 |
| | 675.79 | 677.37 | 678.95 | 680.53 | 682.11 | 683.68 | 685.26 | 686.84 | 688.42 | 690.00 |
| FLOW | 0.00 | 136.05 | 786.24 | 2242.54 | 4748.53 | 8521.67 | 13761.91 | 21746.29 | 31962.67 | 43807.78 |
| | 57241.17 | 72234.86 | 88769.81 | 106854.19 | 126504.35 | 147660.89 | 170308.39 | 194437.22 | 220041.47 | 247117.88 |

MAXIMUM STAGE IS 673.2

MAXIMUM STAGE IS 671.9

MAXIMUM STAGE IS 670.3

MAXIMUM STAGE IS 668.0

MAXIMUM STAGE IS 666.5

MAXIMUM STAGE IS 665.5

MAXIMUM STAGE IS 664.1

MAXIMUM STAGE IS 663.4

MAXIMUM STAGE IS 662.0

**********  **********  **********  **********  **********

HYDROGRAPH ROUTING

ROUTING THRU REACH 4 - 5

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 5 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELINVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 610.0 | 640.0 | 10600. | .00470 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 640.00 100.00 630.00 200.00 620.00 700.00 610.00 710.00 610.00
740.00 620.00 770.00 630.00 800.00 640.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 19.92 | 71.99 | 156.22 | 272.60 | 421.13 | 601.82 | 809.27 | 1025.95 | 1250.52 |
| | 1482.97 | 1723.32 | 1971.55 | 2227.66 | 2491.67 | 2763.56 | 3043.33 | 3331.00 | 3626.54 | 3929.98 |
| OUTFLOW | 0.00 | 108.96 | 605.95 | 1703.21 | 3578.82 | 6392.01 | 10289.35 | 16216.81 | 23788.14 | 32549.92 |
| | 42467.75 | 53516.96 | 65679.78 | 78943.47 | 93299.06 | 108740.48 | 125263.94 | 142867.47 | 161550.54 | 181313.89 |
| STAGE | 610.00 | 611.58 | 613.16 | 614.74 | 616.32 | 617.89 | 619.47 | 621.05 | 622.63 | 624.21 |
| | 625.79 | 627.37 | 628.95 | 630.53 | 632.11 | 633.68 | 635.26 | 636.84 | 638.42 | 640.00 |
| FLOW | 0.00 | 108.96 | 605.95 | 1703.21 | 3578.82 | 6392.01 | 10289.35 | 16216.81 | 23788.14 | 32549.92 |
| | 42467.75 | 53516.96 | 65679.78 | 78943.47 | 93299.06 | 108740.48 | 125263.94 | 142867.47 | 161550.54 | 181313.89 |

MAXIMUM STAGE IS 624.7

MAXIMUM STAGE IS 623.2

MAXIMUM STAGE IS 621.3

MAXIMUM STAGE IS 618.8

MAXIMUM STAGE IS 617.1

MAXIMUM STAGE IS 616.1

MAXIMUM STAGE IS 614.6

MAXIMUM STAGE IS 613.6

MAXIMUM STAGE IS 612.1

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - UPPER MOUNT HOLLY SUBAREA

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 20.86 | 0.00 | 44.43 | 0.00 | 0.000 | 0 | 0 | 0 |

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 23.60 | 98.00 | 107.50 | 117.00 | 130.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .846

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA

TP= 3.21  CP= .54  NTA= 0

RECESSION DATA

STRTQ= -1.50  QRCSN= -.05  RTIOR= 2.00

UNIT HYDROGRAPH 89 END-OF-PERIOD ORDINATES, LAG= 3.20 HOURS, CP= .54 VOL= 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47. | 178. | 364. | 585. | 831. | 1094. | 1371. | 1641. | 1876. | 2065. |
| 2207. | 2300. | 2339. | 2299. | 2183. | 2045. | 1916. | 1796. | 1682. | 1576. |
| 1477. | 1384. | 1297. | 1215. | 1138. | 1066. | 999. | 936. | 877. | 822. |
| 770. | 721. | 676. | 633. | 593. | 556. | 521. | 488. | 457. | 428. |
| 401. | 376. | 352. | 330. | 309. | 290. | 272. | 254. | 238. | 223. |
| 209. | 196. | 184. | 172. | 161. | 151. | 142. | 133. | 124. | 116. |
| 109. | 102. | 96. | 90. | 84. | 79. | 74. | 69. | 65. | 61. |
| 57. | 53. | 50. | 47. | 44. | 41. | 38. | 36. | 34. | 32. |
| 30. | 28. | 26. | 24. | 23. | 21. | 20. | 19. | 18. | |

0 END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| SUM | 25.97 | 23.48 | 2.49 | 1261989. | |
| | ( 660.) | ( 596.) | ( 63.) | (35735.55) | |

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT UPPER MOUNT HOLLY DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 7 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

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**********  **********  **********  **********  **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU UPPER MOUNT HOLLY DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 8 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 0 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 61. | -1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STAGE | 594.00 | 594.50 | 595.00 | 595.50 | 596.00 | 596.70 | 597.00 | 597.50 | 598.00 | 598.50 |
| | 599.00 | 599.50 | 600.00 | 601.00 | 603.00 | 605.00 | 608.00 | | | |
| FLOW | 0.00 | 42.00 | 304.00 | 699.00 | 1193.00 | 2018.00 | 2425.00 | 3532.00 | 5222.00 | 7371.00 |
| | 9864.00 | 12649.00 | 15697.00 | 22490.00 | 38483.00 | 57217.00 | 89703.00 | | | |
| SURFACE AREA= | 0. | 20. | 72. | 104. | | | | | | |
| CAPACITY= | 0. | 61. | 321. | 1196. | | | | | | |
| ELEVATION= | 585. | 594. | 600. | 610. | | | | | | |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 594.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 596.7 | 0.0 | 0.0 | 0. |

PEAK OUTFLOW IS 68138. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 50567. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 32892. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 15705. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 9138. AT TIME 44.50 HOURS

PEAK OUTFLOW IS 5922. AT TIME 44.50 HOURS

PEAK OUTFLOW IS 2789. AT TIME 44.75 HOURS

PEAK OUTFLOW IS 1566. AT TIME 45.25 HOURS

PEAK OUTFLOW IS 465. AT TIME 46.00 HOURS

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1



PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIO 1 | RATIO 2 | RATIO 3 | RATIO 4 | RATIO 5 | RATIO 6 | RATIO 7 | RATIO 8 | RATIO 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | RATIOS APPLIED TO FLOWS | | | | | | | | |
| | | | | 1.00 | .75 | .50 | .25 | .15 | .10 | .05 | .03 | .01 |
| HYDROGRAPH AT | 1 | 23.57 | 1 | 36654. | 27491. | 18327. | 9164. | 5498. | 3665. | 1833. | 1100. | 367. |
| | | ( 61.05) | | ( 1037.94)( | 778.45)( | 518.97)( | 259.48)( | 155.69)( | 103.79)( | 51.90)( | 31.14)( | 10.38) |
| ROUTED TO | 2 | 23.57 | 1 | 36575. | 27426. | 18285. | 9137. | 5479. | 3650. | 1822. | 1094. | 361. |
| | | ( 61.05) | | ( 1035.69)( | 776.61)( | 517.79)( | 258.74)( | 155.15)( | 103.36)( | 51.59)( | 30.97)( | 10.22) |
| ROUTED TO | 3 | 23.57 | 1 | 36393. | 27253. | 18089. | 9002. | 5376. | 3573. | 1769. | 1040. | 343. |
| | | ( 61.05) | | ( 1030.52)( | 771.71)( | 512.22)( | 254.89)( | 152.22)( | 101.19)( | 50.09)( | 29.46)( | 9.71) |
| ROUTED TO | 4 | 23.57 | 1 | 36059. | 26915. | 17774. | 8712. | 5166. | 3398. | 1656. | 966. | 307. |
| | | ( 61.05) | | ( 1021.08)( | 762.15)( | 503.31)( | 246.70)( | 146.28)( | 96.22)( | 46.91)( | 27.34)( | 8.68) |
| ROUTED TO | 5 | 23.57 | 1 | 35797. | 26695. | 17570. | 8506. | 5015. | 3277. | 1577. | 915. | 283. |
| | | ( 61.05) | | ( 1013.67)( | 755.93)( | 497.54)( | 240.86)( | 142.00)( | 92.79)( | 44.65)( | 25.92)( | 8.02) |
| HYDROGRAPH AT | 6 | 20.86 | 1 | 35967. | 26976. | 17984. | 8992. | 5395. | 3597. | 1798. | 1079. | 360. |
| | | ( 54.03) | | ( 1018.48)( | 763.86)( | 509.24)( | 254.62)( | 152.77)( | 101.85)( | 50.92)( | 30.55)( | 10.18) |
| 2 COMBINED | 7 | 44.43 | 1 | 68135. | 50632. | 32938. | 15714. | 9150. | 5924. | 2795. | 1574. | 466. |
| | | ( 115.07) | | ( 1929.37)( | 1433.75)( | 932.69)( | 444.97)( | 259.10)( | 167.74)( | 79.14)( | 44.58)( | 13.21) |
| ROUTED TO | 8 | 44.43 | 1 | 68138. | 50567. | 32892. | 15705. | 9138. | 5922. | 2789. | 1566. | 465. |
| | | ( 115.07) | | ( 1929.47)( | 1431.89)( | 931.41)( | 444.71)( | 258.75)( | 167.68)( | 78.97)( | 44.35)( | 13.15) |

1

SUMMARY OF DAM SAFETY ANALYSIS

LAUREL LAKE DAM

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| 1.00 | 786.76 | .76 | 677. | 36575. | 2.25 | 43.50 | 0.00 |
| .75 | 784.76 | 0.00 | 560. | 27426. | 0.00 | 43.50 | 0.00 |
| .50 | 782.45 | 0.00 | 443. | 18285. | 0.00 | 43.50 | 0.00 |
| .25 | 779.65 | 0.00 | 323. | 9137. | 0.00 | 43.50 | 0.00 |
| .15 | 778.22 | 0.00 | 270. | 5479. | 0.00 | 43.50 | 0.00 |
| .10 | 777.33 | 0.00 | 241. | 3650. | 0.00 | 43.50 | 0.00 |
| .05 | 776.26 | 0.00 | 208. | 1822. | 0.00 | 43.50 | 0.00 |
| .03 | 775.74 | 0.00 | 193. | 1094. | 0.00 | 43.50 | 0.00 |
| .01 | 774.97 | 0.00 | 172. | 361. | 0.00 | 43.75 | 0.00 |

PLAN 1 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|

| RATIO | FLOW,CFS | STAGE,FT | HOURS |
|---|---|---|---|
| 1.00 | 36393. | 711.6 | 43.75 |
| .75 | 27253. | 710.5 | 43.75 |
| .50 | 18089. | 709.1 | 43.75 |
| .25 | 9002. | 707.0 | 43.75 |
| .15 | 5376. | 705.7 | 44.00 |
| .10 | 3573. | 704.9 | 44.00 |
| .05 | 1769. | 703.6 | 44.25 |
| .03 | 1040. | 703.0 | 44.25 |
| .01 | 343. | 701.8 | 44.50 |

PLAN 1 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| 1.00 | 36059. | 673.2 | 44.00 |
| .75 | 26915. | 671.9 | 44.00 |
| .50 | 17774. | 670.3 | 44.25 |
| .25 | 8712. | 668.0 | 44.50 |
| .15 | 5166. | 666.5 | 44.75 |
| .10 | 3398. | 665.5 | 44.75 |
| .05 | 1656. | 664.1 | 45.25 |
| .03 | 966. | 663.4 | 45.50 |
| .01 | 307. | 662.0 | 46.00 |

PLAN 1 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| 1.00 | 35797. | 624.7 | 44.25 |
| .75 | 26695. | 623.2 | 44.50 |
| .50 | 17570. | 621.3 | 44.75 |
| .25 | 8506. | 618.8 | 45.25 |
| .15 | 5015. | 617.1 | 45.50 |
| .10 | 3277. | 616.1 | 45.75 |
| .05 | 1577. | 614.6 | 46.25 |
| .03 | 915. | 613.6 | 46.50 |
| .01 | 283. | 612.1 | 47.50 |

1 SUMMARY OF DAM SAFETY ANALYSIS

UPPER MT. HOLLY DAM

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 593.95 | 594.00 | 596.70 |
| STORAGE | 60. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| 1.00 | 606.01 | 9.31 | 808. | 68138. | 38.75 | 43.75 | 0.00 |
| .75 | 604.29 | 7.59 | 658. | 50567. | 33.25 | 43.75 | 0.00 |
| .50 | 602.30 | 5.60 | 495. | 32892. | 23.25 | 44.00 | 0.00 |
| .25 | 600.00 | 3.30 | 321. | 15705. | 17.75 | 44.25 | 0.00 |
| .15 | 598.85 | 2.15 | 246. | 9138. | 14.25 | 44.50 | 0.00 |
| .10 | 598.16 | 1.46 | 207. | 5922. | 11.50 | 44.50 | 0.00 |
| .05 | 597.16 | .46 | 159. | 2789. | 6.00 | 44.75 | 0.00 |
| .03 | 596.32 | 0.00 | 128. | 1566. | 0.00 | 45.25 | 0.00 |
| .01 | 595.20 | 0.00 | 90. | 465. | 0.00 | 46.00 | 0.00 |

DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
**********

```
A1                  UPPER MOUNT HOLLY DAM    ****    MOUNTAIN CREEK
A2                  BOROUGH OF MOUNT HOLLY SPRINGS, CUMBERLAND COUNTY, PA.
A3                  NDI # PA-00583      PA DER # 21-1
B    300      0     15      0      0      0      0      0     -4      0
B1     5
J      5      1      1
J1   .06
K              1                                   1
K1                  INFLOW HYDROGRAPH - LAUREL LAKE SUBAREA
M      1      1  23.57          44.43                             1
P           23.6     98   107.5    117    130
T                                                   1    .05
W   3.74    .54
X   -1.5   -.05      2
K      1      2                                   1
K1                  RESERVOIR ROUTING - LAUREL LAKE
Y                              1      1
Y1     1                                         160     -1
Y4 774.5  775.5  776.5  777.5  778.5    780    782    784    786    788
Y5     0    760   2150   3950   6080  10078  16590  24189  32720  42090
$A     0     25     30   35.5     40   45.5     52     59   66.5   73.4
$E 755.3  774.5  776.5  778.5    780    782    784    786    788    790
$$ 774.5
$D   786   3.05    1.5    150
K      1      3                                   1
K1                  ROUTING THRU REACH 2 - 3
Y                              1      1
Y1     1
Y6    .1    .07     .1    700    730   7800  .0064
Y7     0    730    100    720    200    710    850    700    860    700
Y7  1100    710   1300    720   1600    730
K      1      4                                   1
K1                  ROUTING THRU REACH 3 - 4
Y                              1      1
Y1     1
Y6    .1    .07     .1    660    690  10300  .0039
Y7     0    690    100    680    150    670    300    660    310    660
Y7   950    670   1120    680   1200    690
K      1      5                                   1
K1                  ROUTING THRU REACH 4 - 5
Y                              1      1
Y1     1
Y6    .1    .07     .1    610    640  10600  .0047
Y7     0    640    100    630    200    620    700    610    710    610
Y7   740    620    770    630    800    640
K              6                                   1
K1                  INFLOW HYDROGRAPH - UPPER MOUNT HOLLY SUBAREA
M      1      1  20.86          44.43                             1
P           23.6     98   107.5    117    130
T                                                   1    .05
W   3.21    .54
X   -1.5   -.05      2
K      2      7                                   1
K1                  COMBINE HYDROGRAPHS AT UPPER MOUNT HOLLY DAM
K      1      8                                   1
K1                  RESERVOIR ROUTING - THRU UPPER MOUNT HOLLY DAM
Y                              1      1
Y1     1                                          61     -1
Y4   594  594.5    595  595.5    596  596.7    597  597.5    598  598.5
Y4   599  599.5    600    601    603    605    608
```

```
Y5  9864   12649   15697   22490   38483   57217   89705
$A     0      20      72     104
$E 584.8     594     600     610
$$   594
$D 596.7
$B    50       1     588     .25     594     700
$B    50       1     588     .25     594   597.2
$B    50       1     588      .5     594   597.2
$B    50       1     588       1     594   597.2
$B    50       1     588       2     594   597.2
K      1       9                                   1
K1                ROUTING THRU REACH 8 - 9
Y                                 1       1
Y1     1
Y6    .1     .07      .1     560     590    4300   .0056
Y7     0     590     100     580     140     570     160     560     190     560
Y7   210     570     250     580     275     590
K     99
1                 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                        RUNOFF HYDROGRAPH AT          1
                        ROUTE HYDROGRAPH TO           2
                        ROUTE HYDROGRAPH TO           3
                        ROUTE HYDROGRAPH TO           4
                        ROUTE HYDROGRAPH TO           5
                        RUNOFF HYDROGRAPH AT          6
                        COMBINE  2 HYDROGRAPHS AT     7
                        ROUTE HYDROGRAPH TO           8
                        ROUTE HYDROGRAPH TO           9
                        END OF NETWORK


1*********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  01 APR 80
 *********************************

 RUN  DATE* 81/02/26.
      TIME* 13.31.50.


                    UPPER MOUNT HOLLY DAM    ****    MOUNTAIN CREEK
                    BOROUGH OF MOUNT HOLLY SPRINGS, CUMBERLAND COUNTY, PA.
                    NDI # PA-00583      PA DER # 21-1

                                JOB SPECIFICATION
          NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
         300       0      15       0       0       0       0       0      -4       0
                                JOPER     NWT   LROPT   TRACE
                                    5       0       0       0


                        MULTI-PLAN ANALYSES TO BE PERFORMED
                            NPLAN= 5 NRTIO= 1 LRTIO= 1
          RTIOS=    .06


          **********        **********        **********        **********        **********
```

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LAUREL LAKE SUBAREA

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 23.57 | 0.00 | 44.43 | 0.00 | 0.000 | 0 | 1 | 0 |

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 23.60 | 98.00 | 107.50 | 117.00 | 130.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .846

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA

TP= 3.74 CP= .54 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.73 HOURS, CP= .54 VOL= .99

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 37. | 139. | 285. | 460. | 655. | 866. | 1089. | 1321. | 1550. | 1755. |
| 1927. | 2065. | 2170. | 2238. | 2266. | 2237. | 2145. | 2029. | 1920. | 1816. |
| 1718. | 1625. | 1538. | 1455. | 1376. | 1302. | 1232. | 1165. | 1102. | 1043. |
| 987. | 933. | 883. | 835. | 790. | 748. | 707. | 669. | 633. | 599. |
| 567. | 536. | 507. | 480. | 454. | 429. | 406. | 384. | 363. | 344. |
| 325. | 308. | 291. | 275. | 261. | 247. | 233. | 221. | 209. | 197. |
| 187. | 177. | 167. | 158. | 150. | 142. | 134. | 127. | 120. | 113. |
| 107. | 101. | 96. | 91. | 86. | 81. | 77. | 73. | 69. | 65. |
| 62. | 58. | 55. | 52. | 49. | 47. | 44. | 42. | 40. | 37. |
| 35. | 33. | 32. | 30. | 28. | 27. | 25. | 24. | 23. | 21. |

0 END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| SUM | 25.97 | 23.48 | 2.49 | 1423079. |
| | ( .60.)( | 596.)( | 63.)( | 40297.11) |

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - LAUREL LAKE

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 160. | -1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STAGE | 774.50 | 775.50 | 776.50 | 777.50 | 778.50 | 780.00 | 782.00 | 784.00 | 786.00 | 788.00 |
| FLOW | 0.00 | 760.00 | 2150.00 | 3950.00 | 6080.00 | 10078.00 | 16590.00 | 24189.00 | 32720.00 | 42090.00 |
| SURFACE AREA= | 0. | 25. | 30. | 36. | 40. | 46. | 52. | 59. | 67. | 73. |
| CAPACITY= | 0. | 160. | 215. | 280. | 337. | 422. | 520. | 631. | 756. | 896. |
| ELEVATION= | 755. | 775. | 777. | 779. | 780. | 782. | 784. | 786. | 788. | 790. |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 774.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 786.0 | 3.1 | 1.5 | 150. |

PEAK OUTFLOW IS 2189. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2189. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2189. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2189. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2189. AT TIME 43.50 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 3 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 700.0 | 730.0 | 7800. | .00640 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 730.00 100.00 720.00 200.00 710.00 850.00 700.00 860.00 700.00
1100.00 710.00 1300.00 720.00 1600.00 730.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 22.69 | 85.12 | 187.27 | 329.16 | 510.78 | 732.13 | 987.35 | 1257.44 | 1540.91 |
| | 1837.78 | 2148.04 | 2471.69 | 2808.99 | 3163.15 | 3535.16 | 3925.03 | 4332.76 | 4758.35 | 5201.79 |
| OUTFLOW | 0.00 | 192.38 | 1122.34 | 3212.37 | 6814.52 | 12242.90 | 19786.34 | 31286.85 | 46026.29 | 63155.61 |
| | 82631.96 | 104428.53 | 128530.21 | 154873.49 | 183454.83 | 214433.76 | 247839.40 | 283704.36 | 322063.25 | 362951.98 |
| STAGE | 700.00 | 701.58 | 703.16 | 704.74 | 706.32 | 707.89 | 709.47 | 711.05 | 712.63 | 714.21 |
| | 715.79 | 717.37 | 718.95 | 720.53 | 722.11 | 723.68 | 725.26 | 726.84 | 728.42 | 730.00 |
| FLOW | 0.00 | 192.38 | 1122.34 | 3212.37 | 6814.52 | 12242.90 | 19786.34 | 31286.85 | 46026.29 | 63155.61 |
| | 82631.96 | 104428.53 | 128530.21 | 154873.49 | 183454.83 | 214433.76 | 247839.40 | 283704.36 | 322063.25 | 362951.98 |

MAXIMUM STAGE IS 703.9

MAXIMUM STAGE IS 703.9

MAXIMUM STAGE IS 703.9

MAXIMUM STAGE IS 703.9

MAXIMUM STAGE IS 703.9

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HYDROGRAPH ROUTING

ROUTING THRU REACH 3 - 4

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME
ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 660.0 | 690.0 | 10300. | .00390 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 690.00 100.00 680.00 150.00 670.00 300.00 660.00 310.00 660.00
950.00 670.00 1120.00 680.00 1200.00 690.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 27.02 | 100.61 | 220.77 | 387.50 | 600.80 | 860.67 | 1157.65 | 1473.46 | 1800.24 |
| | 2139.99 | 2492.71 | 2858.39 | 3236.92 | 3626.58 | 4026.85 | 4437.73 | 4859.23 | 5291.33 | 5734.04 |
| OUTFLOW | 0.00 | 136.05 | 786.24 | 2242.54 | 4748.53 | 8521.67 | 13761.91 | 21746.29 | 31962.67 | 43807.78 |
| | 57241.17 | 72234.86 | 88769.81 | 106854.19 | 126504.35 | 147660.89 | 170308.39 | 194437.22 | 220041.47 | 247117.88 |
| STAGE | 660.00 | 661.58 | 663.16 | 664.74 | 666.32 | 667.89 | 669.47 | 671.05 | 672.63 | 674.21 |
| | 675.79 | 677.37 | 678.95 | 680.53 | 682.11 | 683.68 | 685.26 | 686.84 | 688.42 | 690.00 |
| FLOW | 0.00 | 136.05 | 786.24 | 2242.54 | 4748.53 | 8521.67 | 13761.91 | 21746.29 | 31962.67 | 43807.78 |
| | 57241.17 | 72234.86 | 88769.81 | 106854.19 | 126504.35 | 147660.89 | 170308.39 | 194437.22 | 220041.47 | 247117.88 |

MAXIMUM STAGE IS 664.5

MAXIMUM STAGE IS 664.5

MAXIMUM STAGE IS 664.5

MAXIMUM STAGE IS 664.5

MAXIMUM STAGE IS 664.5

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HYDROGRAPH ROUTING

ROUTING THRU REACH 4 - 5

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 5 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 610.0 | 640.0 | 10600. | .00470 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 640.00 100.00 630.00 200.00 620.00 700.00 610.00 710.00 610.00
740.00 620.00 770.00 630.00 800.00 640.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 19.92 | 71.99 | 156.22 | 272.60 | 421.13 | 601.82 | 809.27 | 1025.95 | 1250.52 |
| | 1482.97 | 1723.32 | 1971.55 | 2227.66 | 2491.67 | 2763.56 | 3043.33 | 3331.00 | 3626.54 | 3929.98 |
| OUTFLOW | 0.00 | 108.96 | 605.95 | 1703.21 | 3578.82 | 6392.01 | 10289.35 | 16216.81 | 23788.14 | 32549.92 |
| | 42467.75 | 53516.96 | 65679.78 | 78943.47 | 93299.06 | 108740.48 | 125263.94 | 142867.47 | 161550.54 | 181313.89 |
| STAGE | 610.00 | 611.58 | 613.16 | 614.74 | 616.32 | 617.89 | 619.47 | 621.05 | 622.63 | 624.21 |
| | 625.79 | 627.37 | 628.95 | 630.53 | 632.11 | 633.68 | 635.26 | 636.84 | 638.42 | 640.00 |
| FLOW | 0.00 | 108.96 | 605.95 | 1703.21 | 3578.82 | 6392.01 | 10289.35 | 16216.81 | 23788.14 | 32549.92 |
| | 42467.75 | 53516.96 | 65679.78 | 78943.47 | 93299.06 | 108740.48 | 125263.94 | 142867.47 | 161550.54 | 181313.89 |

MAXIMUM STAGE IS 614.9

MAXIMUM STAGE IS 614.9

MAXIMUM STAGE IS 614.9

MAXIMUM STAGE IS 614.9

MAXIMUM STAGE IS 614.9

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - UPPER MOUNT HOLLY SUBAREA

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 20.86 | 0.00 | 44.43 | 0.00 | 0.000 | 0 | 1 | 0 |

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 23.60 | 98.00 | 107.50 | 117.00 | 130.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .846

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA

TP= 3.21 CP= .54 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 89 END-OF-PERIOD ORDINATES, LAG= 3.20 HOURS, CP= .54 VOL= 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47. | 178. | 364. | 585. | 831. | 1094. | 1371. | 1641. | 1876. | 2065. |
| 2207. | 2300. | 2339. | 2299. | 2183. | 2045. | 1916. | 1796. | 1682. | 1576. |
| 1477. | 1384. | 1297. | 1215. | 1138. | 1066. | 999. | 936. | 877. | 822. |
| 770. | 721. | 676. | 633. | 593. | 556. | 521. | 488. | 457. | 428. |
| 401. | 376. | 352. | 330. | 309. | 290. | 272. | 254. | 238. | 223. |
| 209. | 196. | 184. | 172. | 161. | 151. | 142. | 133. | 124. | 116. |
| 109. | 102. | 96. | 90. | 84. | 79. | 74. | 69. | 65. | 61. |
| 57. | 53. | 50. | 47. | 44. | 41. | 38. | 36. | 34. | 32. |
| 30. | 28. | 26. | 24. | 23. | 21. | 20. | 19. | 18. | |

0 END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| SUM | 25.97 | 23.48 | 2.49 | 1261989. |
| | ( 660.) | ( 596.) | ( 63.) | (35735.55) |

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT UPPER MOUNT HOLLY DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 7 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU UPPER MOUNT HOLLY DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 8 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 61. | -1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STAGE | 594.00 | 594.50 | 595.00 | 595.50 | 596.00 | 596.70 | 597.00 | 597.50 | 598.00 | 598.50 |
| | 599.00 | 599.50 | 600.00 | 601.00 | 603.00 | 605.00 | 608.00 | | | |
| FLOW | 0.00 | 42.00 | 304.00 | 699.00 | 1193.00 | 2018.00 | 2425.00 | 3532.00 | 5222.00 | 7371.00 |
| | 9864.00 | 12649.00 | 15697.00 | 22490.00 | 38483.00 | 57217.00 | 89705.00 | | | |
| SURFACE AREA= | 0. | 20. | 72. | 104. | | | | | | |
| CAPACITY= | 0. | 61. | 321. | 1196. | | | | | | |
| ELEVATION= | 585. | 594. | 600. | 610. | | | | | | |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 594.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 596.7 | 0.0 | 0.0 | 0. |

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 50. | 1.00 | 588.00 | .25 | 594.00 | 700.00 |

PEAK OUTFLOW IS 3381. AT TIME 44.75 HOURS

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 50. | 1.00 | 588.00 | .25 | 594.00 | 597.20 |

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 6635. AT TIME 43.25 HOURS

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 50. | 1.00 | 588.00 | .50 | 594.00 | 597.20 |

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 5943. AT TIME 43.50 HOURS

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 50. | 1.00 | 588.00 | 1.00 | 594.00 | 597.20 |

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 5113. AT TIME 44.00 HOURS

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 50. | 1.00 | 588.00 | 2.00 | 594.00 | 597.20 |

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 4379. AT TIME 45.00 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 8 - 9

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 9 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

ALL PLANS HAVE SAME ROUTING DATA

| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 |

| NSTPS | NSTDL | LAG | AMSKK | X | TSK | STORA | ISPRAT |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0700 | .1000 | 560.0 | 590.0 | 4300. | .00560 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 590.00 100.00 580.00 140.00 570.00 160.00 560.00 190.00 560.00
210.00 570.00 250.00 580.00 275.00 590.00

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 5.17 | 11.32 | 18.46 | 26.58 | 35.68 | 45.78 | 57.07 | 70.28 | 85.45 |
| | 102.60 | 121.71 | 142.79 | 165.91 | 191.85 | 220.87 | 252.97 | 288.14 | 326.39 | 367.71 |
| OUTFLOW | 0.00 | 104.99 | 345.33 | 706.46 | 1190.17 | 1801.85 | 2548.20 | 3559.53 | 4806.53 | 6249.73 |
| | 7903.93 | 9782.42 | 11897.63 | 14240.12 | 16832.79 | 19742.83 | 22985.20 | 26577.83 | 30539.33 | 34888.18 |
| STAGE | 560.00 | 561.58 | 563.16 | 564.74 | 566.32 | 567.89 | 569.47 | 571.05 | 572.63 | 574.21 |
| | 575.79 | 577.37 | 578.95 | 580.53 | 582.11 | 583.68 | 585.26 | 586.84 | 588.42 | 590.00 |
| FLOW | 0.00 | 104.99 | 345.33 | 706.46 | 1190.17 | 1801.85 | 2548.20 | 3559.53 | 4806.53 | 6249.73 |
| | 7903.93 | 9782.42 | 11897.63 | 14240.12 | 16832.79 | 19742.83 | 22985.20 | 26577.83 | 30539.33 | 34888.18 |

MAXIMUM STAGE IS 570.8

MAXIMUM STAGE IS 573.4

MAXIMUM STAGE IS 572.9

MAXIMUM STAGE IS 572.6

MAXIMUM STAGE IS 572.0

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1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS RATIO 1 .06 |
|---|---|---|---|---|
| HYDROGRAPH AT | 1 | 23.57 | 1 | 2199. |
| | | ( 61.05) | | ( 62.28)( |
| | | | 2 | 2199. |
| | | | | ( 62.28)( |
| | | | 3 | 2199. |
| | | | | ( 62.28)( |
| | | | 4 | 2199. |
| | | | | ( 62.28)( |
| | | | 5 | 2199. |
| | | | | ( 62.28)( |
| ROUTED TO | 2 | 23.57 | 1 | 2189. |
| | | ( 61.05) | | ( 62.00)( |
| | | | 2 | 2189. |
| | | | | ( 62.00)( |
| | | | 3 | 2189. |
| | | | | ( 62.00)( |
| | | | 4 | 2189. |
| | | | | ( 62.00)( |
| | | | 5 | 2189. |
| | | | | ( 62.00)( |
| ROUTED TO | 3 | 23.57 | 1 | 2124. |
| | | ( 61.05) | | ( 60.14)( |
| | | | 2 | 2124. |
| | | | | ( 60.14)( |
| | | | 3 | 2124. |
| | | | | ( 60.14)( |
| | | | 4 | 2124. |
| | | | | ( 60.14)( |
| | | | 5 | 2124. |
| | | | | ( 60.14)( |
| ROUTED TO | 4 | 23.57 | 1 | 1994. |
| | | ( 61.05) | | ( 56.47)( |
| | | | 2 | 1994. |
| | | | | ( 56.47)( |
| | | | 3 | 1994. |
| | | | | ( 56.47)( |
| | | | 4 | 1994. |
| | | | | ( 56.47)( |
| | | | 5 | 1994. |
| | | | | ( 56.47)( |

| | | | |
|---|---|---|---|
| ROUTED TO | 5 | 23.57 | 1 1919. |
| | ( | 61.05) | ( 54.35)( |
| | | | 2 1919. |
| | | | ( 54.35)( |
| | | | 3 1919. |
| | | | ( 54.35)( |
| | | | 4 1919. |
| | | | ( 54.35)( |
| | | | 5 1919. |
| | | | ( 54.35)( |
| HYDROGRAPH AT | 6 | 20.86 | 1 2158. |
| | ( | 54.03) | ( 61.11)( |
| | | | 2 2158. |
| | | | ( 61.11)( |
| | | | 3 2158. |
| | | | ( 61.11)( |
| | | | 4 2158. |
| | | | ( 61.11)( |
| | | | 5 2158. |
| | | | ( 61.11)( |
| 2 COMBINED | 7 | 44.43 | 1 3388. |
| | ( | 115.07) | ( 95.94)( |
| | | | 2 3388. |
| | | | ( 95.94)( |
| | | | 3 3388. |
| | | | ( 95.94)( |
| | | | 4 3388. |
| | | | ( 95.94)( |
| | | | 5 3388. |
| | | | ( 95.94)( |
| ROUTED TO | 8 | 44.43 | 1 3381. |
| | ( | 115.07) | ( 95.73)( |
| | | | 2 6635. |
| | | | ( 187.89)( |
| | | | 3 5943. |
| | | | ( 168.27)( |
| | | | 4 5113. |
| | | | ( 144.77)( |
| | | | 5 4379. |
| | | | ( 124.00)( |
| ROUTED TO | 9 | 44.43 | 1 3379. |
| | ( | 115.07) | ( 95.68)( |
| | | | 2 5477. |
| | | | ( 155.09)( |
| | | | 3 5041. |
| | | | ( 142.74)( |
| | | | 4 4750. |
| | | | ( 134.51)( |
| | | | 5 4330. |
| | | | ( 122.61)( |

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 776.52 | 0.00 | 216. | 2189. | 0.00 | 43.50 | 0.00 |

PLAN 2 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 776.52 | 0.00 | 216. | 2189. | 0.00 | 43.50 | 0.00 |

PLAN 3 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 776.52 | 0.00 | 216. | 2189. | 0.00 | 43.50 | 0.00 |

PLAN 4 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 776.52 | 0.00 | 216. | 2189. | 0.00 | 43.50 | 0.00 |

PLAN 5 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 774.50 | 774.50 | 786.00 |
| STORAGE | 160. | 160. | 631. |
| OUTFLOW | 0. | 0. | 32720. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 776.52 | 0.00 | 216. | 2189. | 0.00 | 43.50 | 0.00 |

PLAN 1 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 2124. | 703.9 | 44.00 |

PLAN 2 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 2124. | 703.9 | 44.00 |

PLAN 3 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 2124. | 703.9 | 44.00 |

PLAN 4 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 2124. | 703.9 | 44.00 |

PLAN 5 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 2124. | 703.9 | 44.00 |

PLAN 1 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1994. | 664.5 | 45.25 |

PLAN 2 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1994. | 664.5 | 45.25 |

PLAN 3 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1994. | 664.5 | 45.25 |

PLAN 4 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1994. | 664.5 | 45.25 |

PLAN 5 STATION 4

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1994. | 664.5 | 45.25 |

PLAN 1 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1919. | 614.9 | 46.00 |

PLAN 2 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1919. | 614.9 | 46.00 |

PLAN 3 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1919. | 614.9 | 46.00 |

PLAN 4 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1919. | 614.9 | 46.00 |

PLAN 5 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 1919. | 614.9 | 46.00 |

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 594.00 | 594.00 | 596.70 |
| STORAGE | 61. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 597.43 | .73 | 171. | 3381. | 7.75 | 44.75 | 0.00 |

PLAN 2 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 594.00 | 594.00 | 596.70 |
| STORAGE | 61. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 597.27 | .57 | 164. | 6635. | 1.76 | 43.25 | 43.00 |

PLAN 3 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 594.00 | 594.00 | 596.70 |
| STORAGE | 61. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 597.27 | .57 | 164. | 5943. | 1.94 | 43.50 | 43.00 |

PLAN 4 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 594.00 | 594.00 | 596.70 |
| STORAGE | 61. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 597.29 | .59 | 165. | 5113. | 2.29 | 44.00 | 43.00 |

PLAN 5 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 594.00 | 594.00 | 596.70 |
| STORAGE | 61. | 61. | 140. |
| OUTFLOW | 0. | 0. | 2018. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .06 | 597.31 | .61 | 166. | 4379. | 2.96 | 45.00 | 43.00 |

PLAN 1 STATION 9

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 3379. | 570.8 | 45.00 |

PLAN 2 STATION 9

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 5477. | 573.4 | 43.50 |

PLAN 3 STATION 9

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 5041. | 572.9 | 43.75 |

PLAN 4 STATION 9

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 4750. | 572.6 | 44.00 |

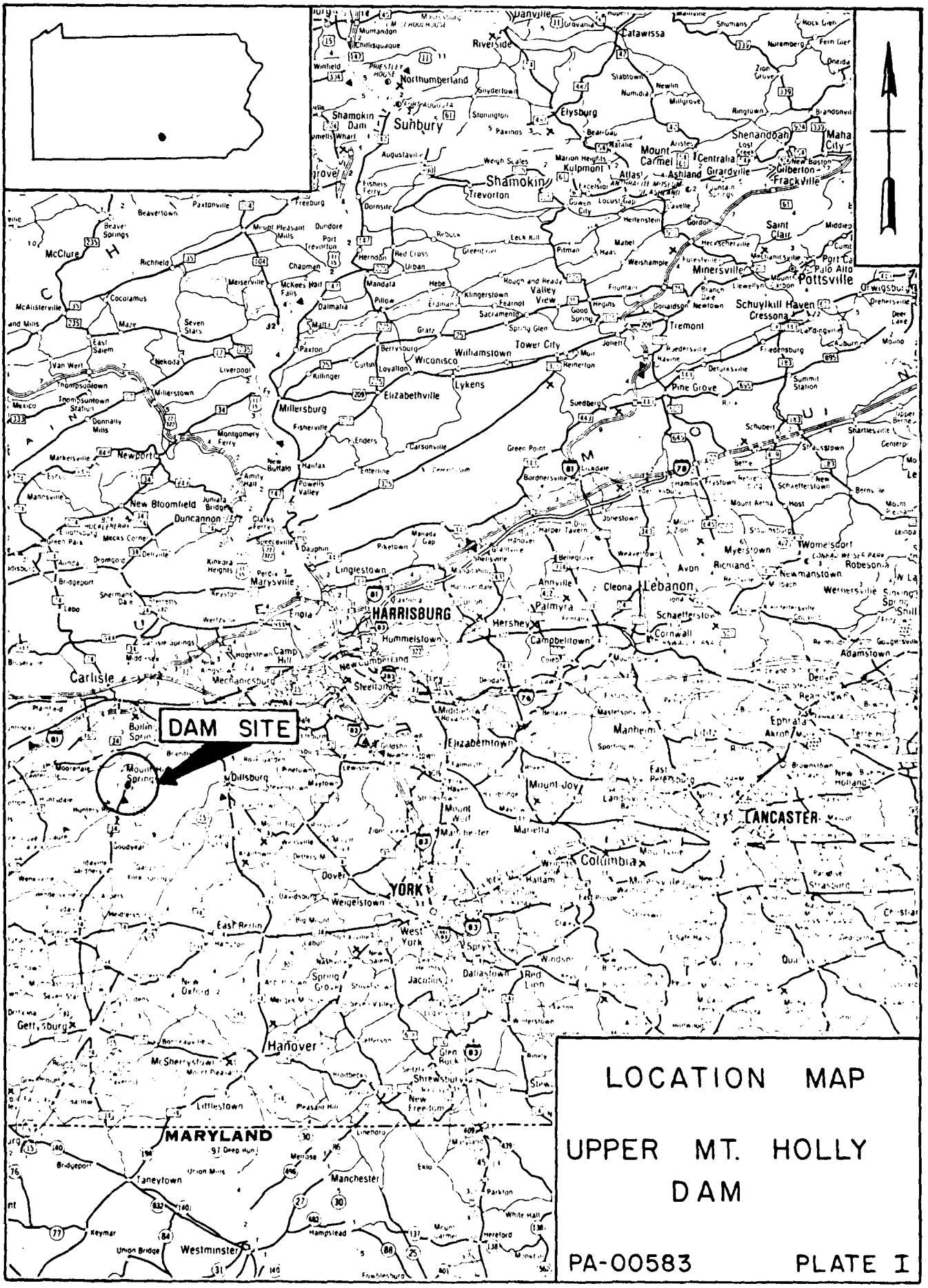
PLAN 5 STATION 9

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .06 | 4330. | 572.0 | 45.00 |

EOI ENCOUNTERED.
N>

# APPENDIX E

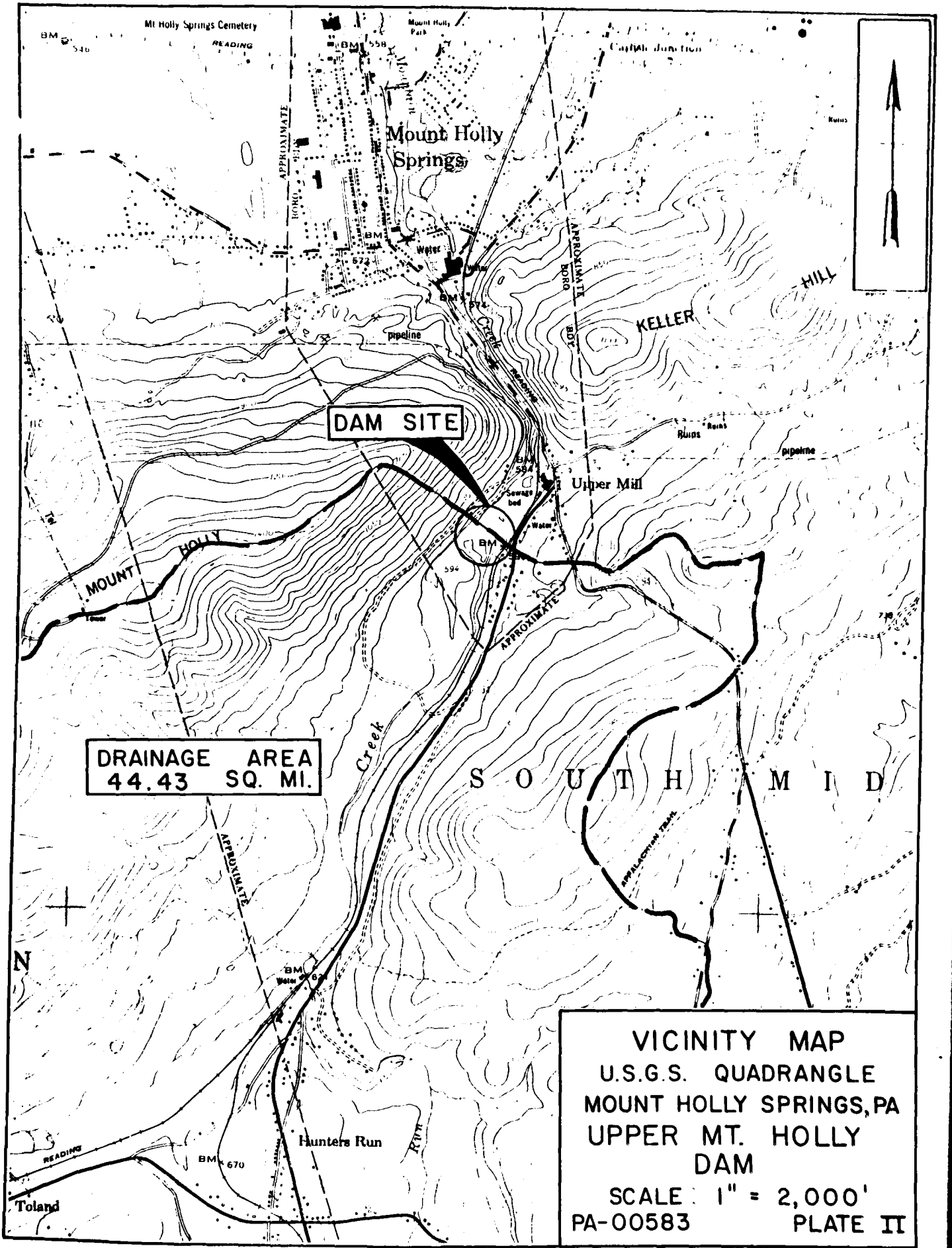
# PLATES




# LOCATION MAP

## UPPER MT. HOLLY DAM

PA-00583 PLATE I




# VICINITY MAP

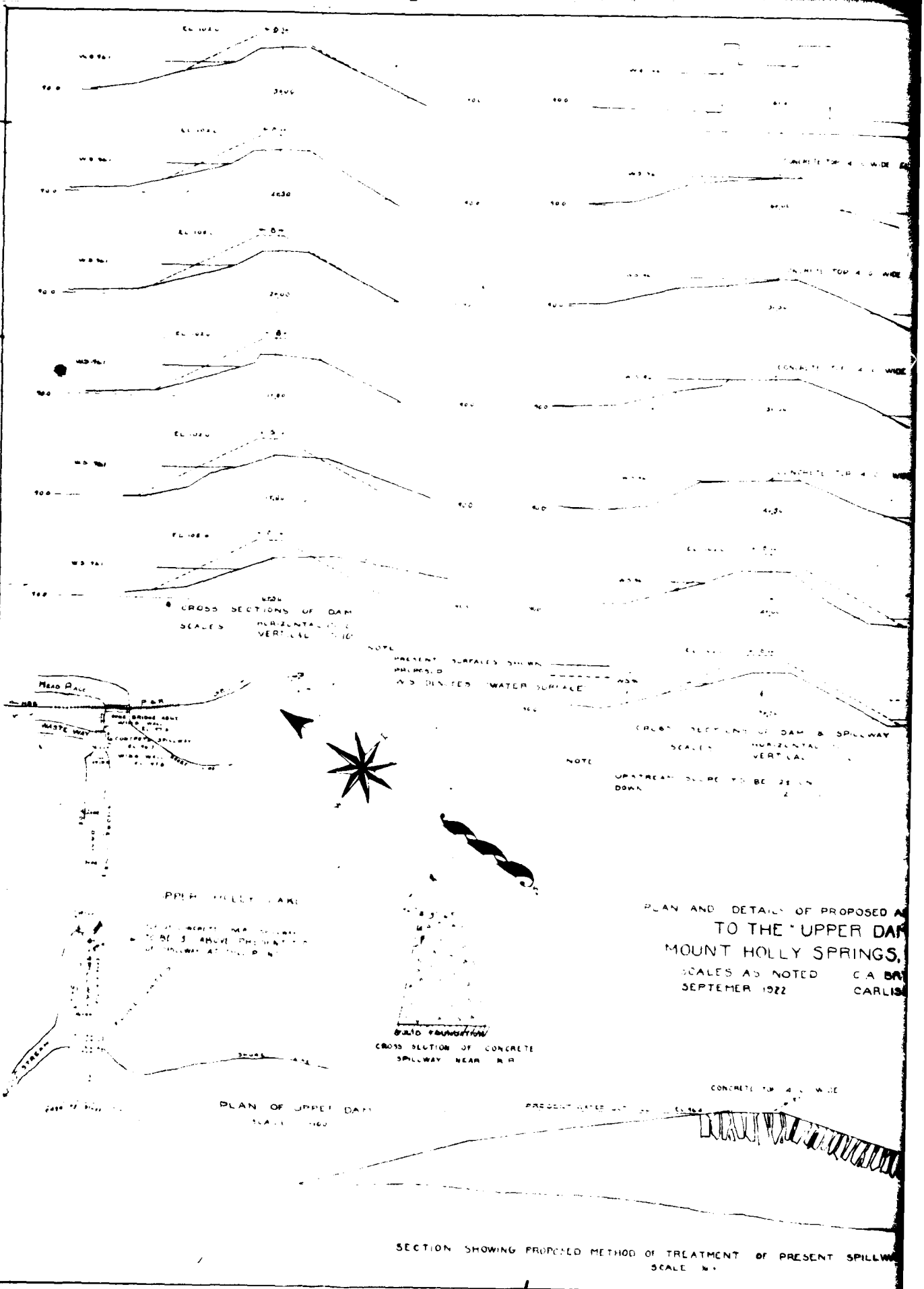
U.S.G.S. QUADRANGLE

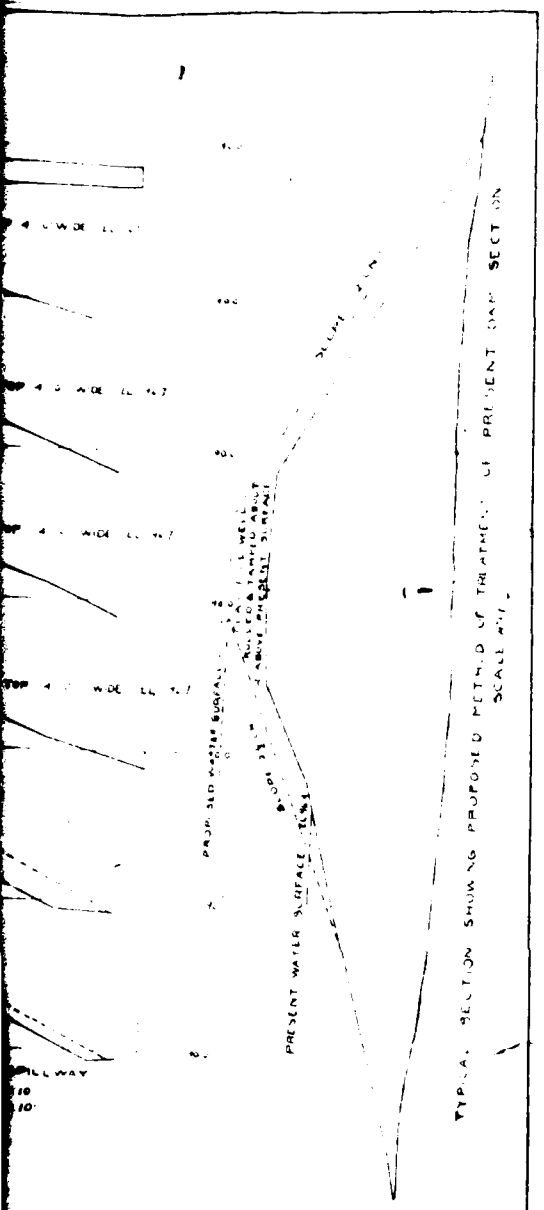
MOUNT HOLLY SPRINGS, PA

UPPER MT. HOLLY DAM

SCALE 1" = 2,000'

PA-00583 PLATE II


CROSS SECTIONS OF DAM
SCALES
NOTE
PRESENT SURFACES SHOWN
PROPOSED
W.S. DENOTES WATER SURFACE
CROSS SECTIONS OF DAM & SPILLWAY
SCALES
NOTE
UPSTREAM SLOPE TO BE
DOWN
HEAD RACE
WASTE WAY
UPPER HOLLY LAKE
PLAN AND DETAILS OF PROPOSED A
TO THE UPPER DAM
MOUNT HOLLY SPRINGS,
SCALES AS NOTED
SEPTEMER 1922
CARLIS
SOLID FOUNDATION
CROSS SECTION OF CONCRETE
SPILLWAY NEAR R.R.
PLAN OF UPPER DAM
SECTION SHOWING PROPOSED METHOD OF TREATMENT OF PRESENT SPILLW
SCALE



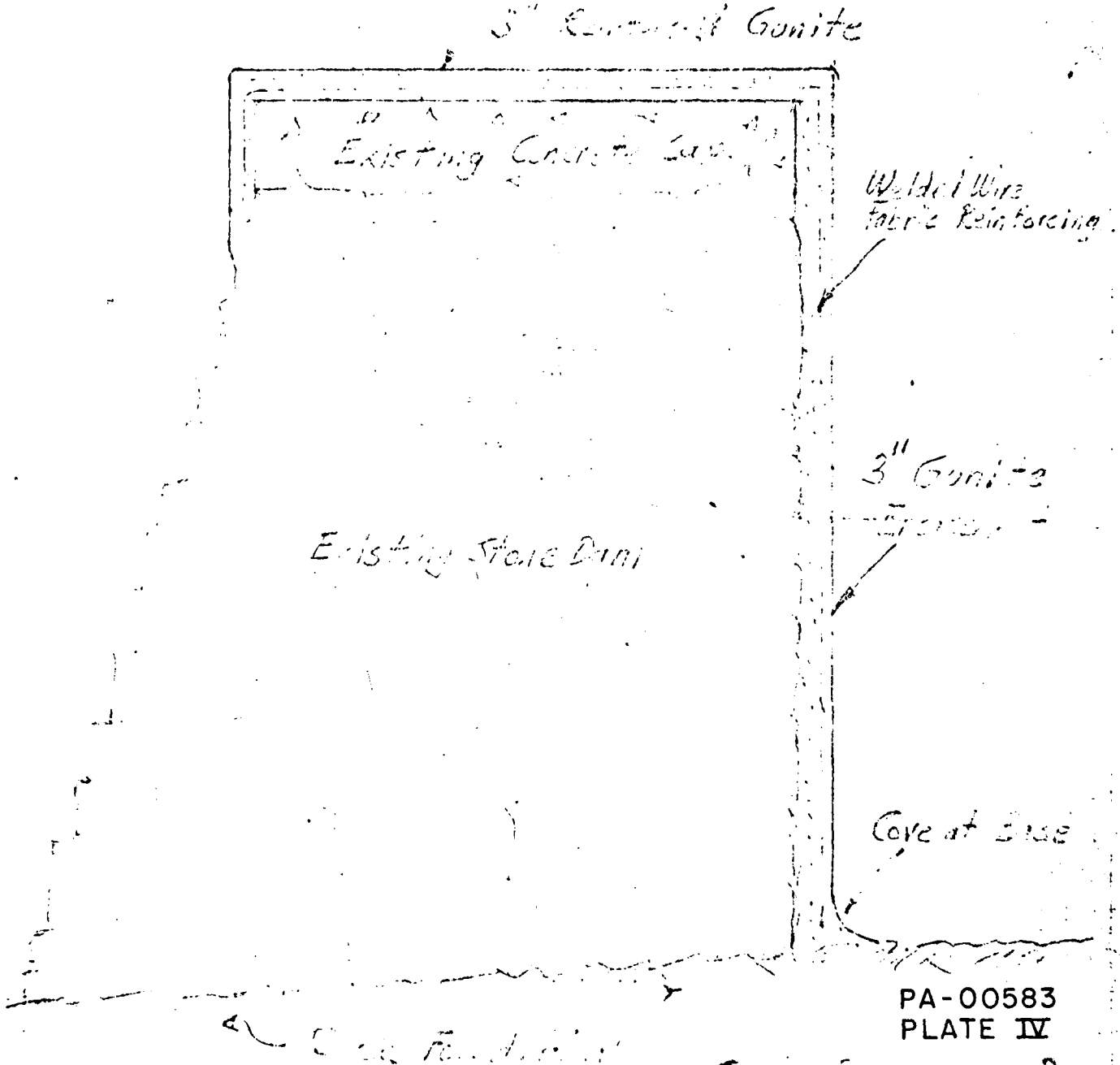

TYPICAL SECTION SHOWING PROPOSED METHOD OF TREATMENT OF PRESENT DAM
SCALE

POSED ALTERATIONS
ER DAM
RINGS, PENNA.
C A BRYAN CE
CARLISLE PENNA

ILLWAY SECTION

PA-00583
PLATE III

139581




PA-00583
PLATE IV

Cross Section of Dam

GUNITE CONSTRUCTION CO.
A CORPORATION OF NEW YORK
JULY 5, 1932

PROPOSED REPAIR TO DAM
THE EATON-DIKEMAN CO.
MOUNT HOLLY SPRINGS, PA.

# APPENDIX F

# GEOLOGIC REPORT

AD-A101 272 BERGER ASSOCIATES INC HARRISBURG PA FLD 1
NATIONAL DAM INSPECTION PROGRAM. UPPER MT. HOLLY DAM (NDI NUMBE--ETC(U)
JUN 81 H JONGSMA DACW31-81-C-0013
UNCLASSIFIED NL

# GEOLOGIC REPORT

## BEDROCK - DAM AND RESERVOIR

This area overlies the Tomstown Dolomite which consists of a medium to dark gray, dense, finely crystalline domolite and weathers to a buff and olive-gray color.

## STRUCTURE

There exists a NE striking fault on the NW border of the reservoir, with the upthrown side to the north and the downthrown side to the south. Joints, which are moderately abundant and well developed, have a blocky pattern and dip between 45-85°. The Mountain Creek Syncline occurs along the SE border of the reservoir.

## OVERBURDEN

The overburden is most probably a clayey residual soil resulting from the carbonate leaching of the parent bedrock.

## AQUIFER CHARACTERISTICS

The Tomstown Dolomite has a low magnitude secondary porosity and little subsurface drainage, therefore seepage should be minimal.

## DISCUSSION

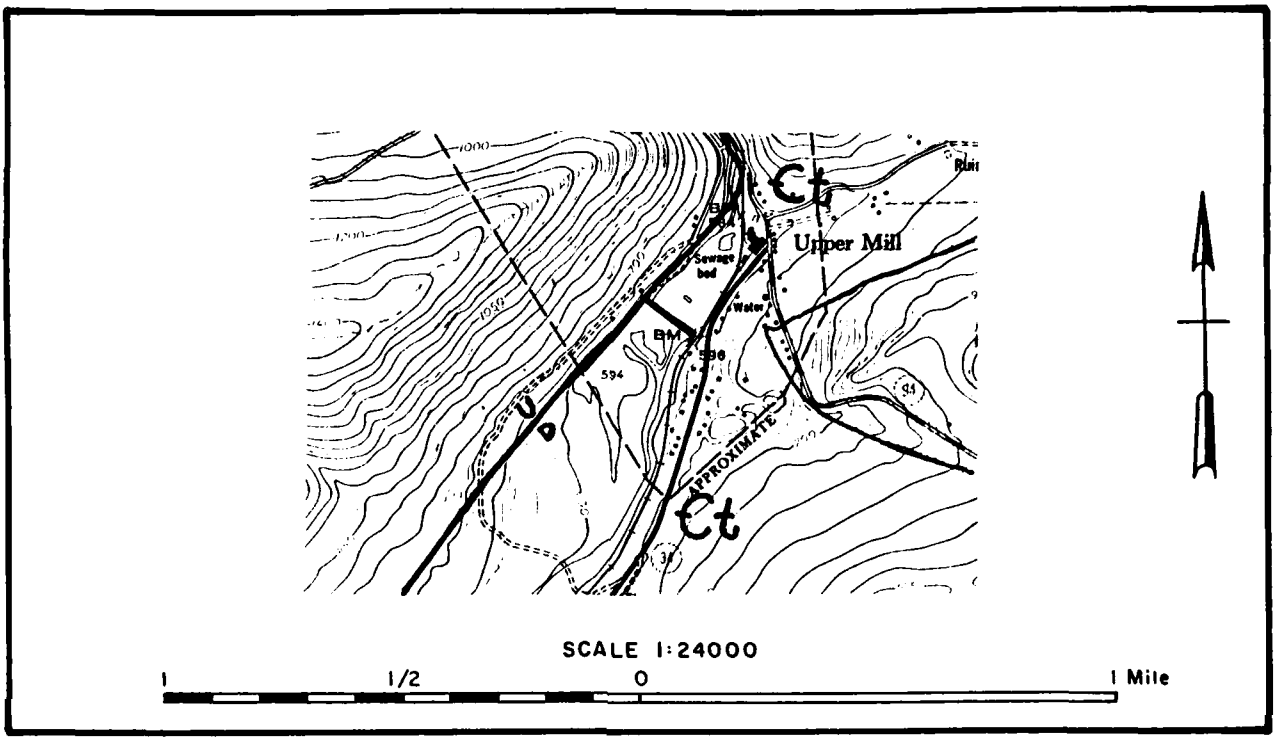
According to available construction plans, the dam rests on bedrock. If such is the case, the Tomstown Dolomite provides a good quality foundation for heavy structures. However, as with any carbonate rock, sinkholes and bedrock pinnacles should be thoroughly investigated.

## SOURCES OF INFORMATION


1. Freedman, J., 1967. Geology or a Portion of the Mt. Holly Springs Quadrangle, Adams and Cumberland Counties, Pennsylvania: Pennsylvania Geological Survey PR 169.

2. McGlade, W.G., et. al., 1972. Engineering Characteristics of the Rocks of Pennsylvania: Pennsylvania Geological Survey EG 1.

GEOLOGIC MAP - UPPER MT. HOLLY DAM




## LEGEND

Ct — Tomstown Dolomite

U / D — Fault